7.0 WATERSHED RESTORATION

During the past year, Frederick County has worked on a number of initiatives to monitor, assess, protect, and restore watersheds. The following sections provide monitoring and assessment results, and summarizes progress on County watershed protection and restoration efforts.

7.1 STREAM MONITORING TO IDENTIFY AND EVALUATE WATER QUALITY PROBLEMS

From 1999-2007, Frederick County made efforts to identify and evaluate water quality problems in its priority watersheds (Appendix J) and subwatersheds by conducting, on a rotating basis, stream monitoring using both biological and physical habitat methods. Through 2006, monitoring was conducted every two to three years in the County's three highest priority watersheds: Lower Bush Creek, Ballenger Creek, and Lower Linganore Creek.

In 2008, the County undertook two separate monitoring efforts. First, the County conducted targeted monitoring in Ballenger Creek, Bennett Creek, and Linganore Creek in support of on-going and potential future restoration and community outreach efforts (Section 7.2). Second, the County conducted the first full year of County-wide stream sampling for the Frederick County Stream Survey (FCSS). Both of these monitoring efforts continued in 2009.

7.2 BIOLOGICAL AND PHYSICAL STREAM ASSESSMENT

In 2009, the County surveyed stream conditions at 9 locations in Ballenger, Linganore, and Bennett Creeks (Figure 7-1, Table 7-1). BALL-04, BALL-07, BENN-03, and BENN-05, had all been sampled in prior years due to their association with planned or on-going restoration projects. Construction of the stream restoration project at BALL-04 took place prior to 2008 spring sampling. Site LING-18 was established in Pinecliff Park for pre-restoration monitoring. BENN-07, BENN-08, BENN-09, and BENN-10 are newly established sites on Bear Branch, along Mount Ephraim Road, to monitor stream condition prior to replacement of a pipe culvert.

The Ballenger Creek watershed is approximately 14,900 acres (23 square miles) in size and the creek is designated by MDE as Class III Natural Trout Waters (FCDPZ 1998). The creek drains eastward into the Monocacy River, which it joins near the Monocacy National Battlefield. Ballenger Creek was selected as the second watershed to be assessed under Frederick County's NPDES stormwater permit because of substantial growth in the north-central and eastern portions of the watershed, near the City of Frederick. The western half of the watershed contains large tracts of agricultural and forested land; however, residential uses are expanding.

The Lower Linganore Creek watershed is approximately 24,350 acres (38 square miles) in size, which is slightly less than half the drainage area for the entire Linganore Creek. Linganore Creek drains westward from just inside the western edge of Carroll County and passes through several earth dams in the central portion of the lower watershed. The Lower Linganore watershed is a mix of forested, agricultural, and residential land located east-northeast of the City of Frederick.

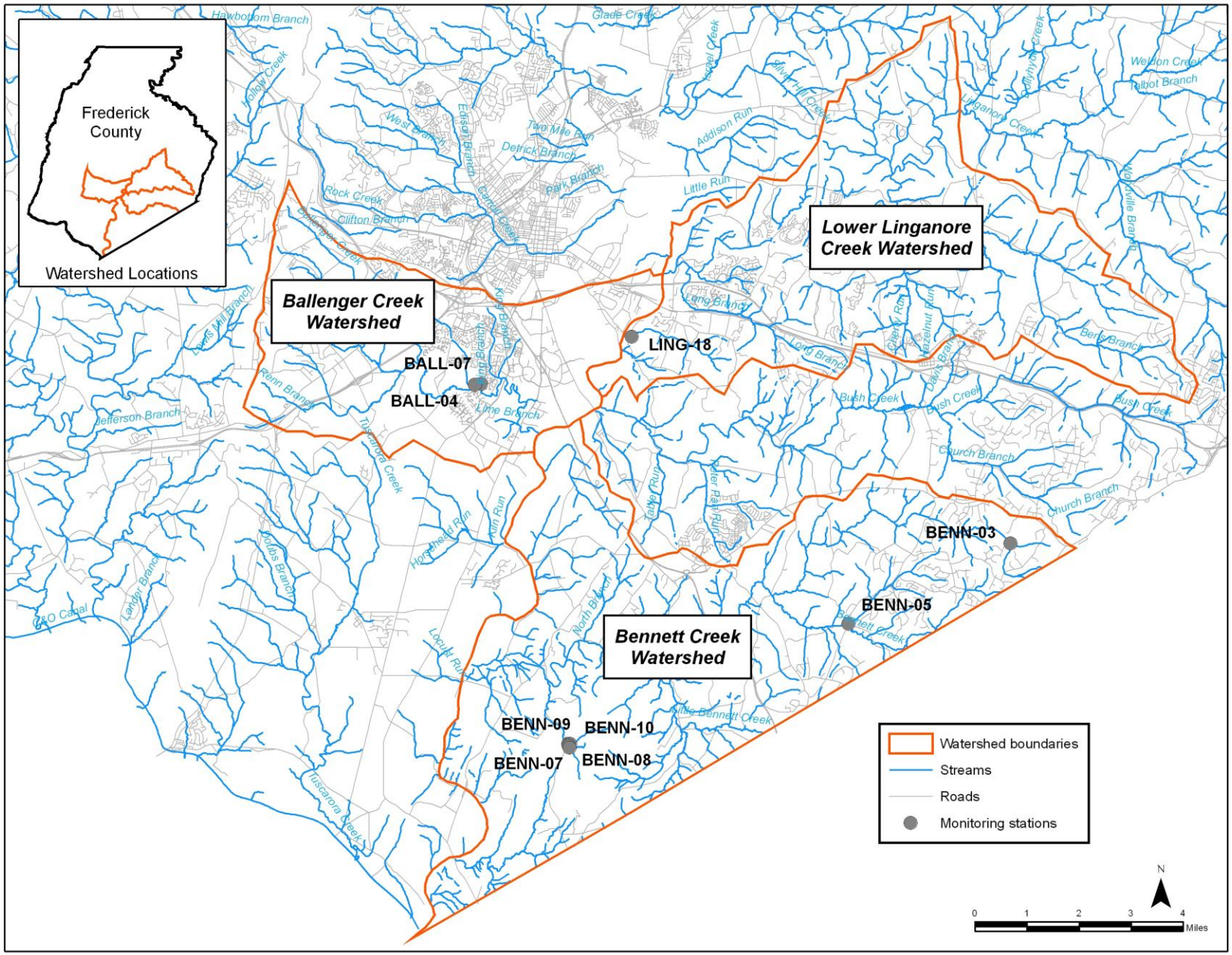

Figure 7-1. 2009 stream monitoring locations within Ballenger Creek, Bennett Creek, and Linganore Creek watersheds

Linganore Creek has been classified by MDE as Class IV, Recreational Trout Waters (FCDPZ 1998). This watershed was selected as the third to be assessed under Frederick County's NPDES stormwater permit. It was considered a high priority for assessment because of its close proximity to the City of Frederick, concerns for Lake Linganore water quality, and recent, significant residential development in the Lake Linganore area. A large majority of the remaining agricultural and forested land near the lake has been zoned for Planned Unit Development (PUD), indicating that the intensity of land use will likely continue to increase.

Table 7-1. Stream stations monitored by Frederick County in 2009

Site Name	Site Location	Rationale for Selection
Ballenger Creek Watershed		
BALL-04	Ballenger Creek at Ballenger Creek Elementary School	Resample long-term monitoring station in priority watershed; pre-restoration monitoring for stream stabilization project
BALL-07	Ballenger Creek above Ballenger Creek Elementary School	Comparison of pre- and post-restoration differences at BALL-04, located immediately downstream
Linganore Creek Watershed		
LING-18	Tributary that drains directly to the Monocacy River, between road culvert and footbridge	Pre-restoration monitoring
Bennett Creek Watershed		
BENN-03	Fahrney Branch in Kemptown Community Park on Kemptown Church Road	Restoration monitoring
BENN-05	Pleasant Branch, downstream of intersection of Price's Distillery Road and Green Valley Road	Restoration monitoring
BENN-07	Bear Branch, downstream of tributary and Mount Ephraim Road culvert	Monitoring prior to initiation of Mount Ephraim Road culvert replacement project
BENN-08	Tributary that drains to Bear Branch after crossing over Mount Ephraim Road	Monitoring prior to initiation of Mount Ephraim Road culvert replacement project
BENN-09	Bear Branch, between Mount Ephraim Road culvert and confluence with tributary	Monitoring prior to initiation of Mount Ephraim Road culvert replacement project
BENN-10	Bear Branch, upstream of Mount Ephraim Road culvert	Monitoring prior to initiation of Mount Ephraim Road culvert replacement project

The Bennett Creek watershed is approximately 31,000 acres (48.5 square miles) of forested, agricultural, and residential land, south of the City of Frederick. It includes lands between the towns of Urbana and Buckeystown and southward. Bennett Creek drains westward into the Monocacy River, joining it one mile north of the Monocacy Natural Resources Management Area. The Creek and its tributaries have been classified by MDE as Class IV Recreational Trout Waters (MDE 2000). A portion of the aquifer in the Bennett Creek watershed has been designated a sole-source aquifer by the U.S. EPA (DUSWM 1998). This designation means it serves as a primary source of drinking water for at least 50% of the population in the area, and special attention is paid to avoid contamination from sources such as landfills. The aquifer has a recharge area of 180 square miles, spanning a large portion of Urbana, as well as parts of Montgomery and Howard Counties.

The county's stream targeted restoration monitoring program is an assessment of physical, chemical, and biological data, collected during designated index periods (Southerland et al. 1999, Morgan and Roth 2005). Sampling in 2009 included collection of water quality data, benthic macroinvertebrate and fish sampling, and quantitative physical habitat assessment. No biological data were collected at BENN-07, BENN-08, BENN-09, or BENN-10. These sites are being monitored by Versar for a project that Frederick County is undertaking in conjunction with the Potomac Conservancy and Maryland DNR. DNR will be collecting fish data at these site locations, independent of Versar's sampling efforts. Biological and physical monitoring methods employed in this survey are described in Section 5.1 of this report. Key findings are summarized below. Tables containing details of sampling results are found in Appendix K.

7.2.1 Water Quality

Water quality sampling, conducted in April and September 2009, generally showed good results. Temperature and conductivity results for all sites were within a normal range. Dissolved oxygen (DO) concentrations were greater than 8.9 mg/l in the spring and greater than 7.6 mg/l in the summer for all sites. All sites maintained DO levels that are typically considered healthy for aquatic biota and were above Maryland's established minimum surface water criterion of 5.0 mg/l. pH values at BENN-05, BENN-07, and BENN-09 were slightly elevated, at 7.99, 8.06, and 8.14, respectively. pH values at the remaining sites ranged from 7.27-7.85 and were comparable to the range of values noted in previous years.

7.2.2 Physical Habitat

MBSS spring habitat and geomorphic data (including cross-sectional surveys, longitudinal profiles, slope, and pebble counts) were collected in April 2009. The geomorphic data collected (and documented in Appendix K) provide a follow-up to previous surveys for existing stations to monitor changes over time, in comparison with baseline data collected in the initial year. Cross-sections, established at each site in a previous sampling year, were re-surveyed in 2009.

While geomorphic assessments do not rate habitat condition, MBSS habitat evaluations performed during either spring or summer sampling (April or September 2009) provide a scored assessment. Percent embeddedness was still low at the Mount Ephraim Road sites (BENN-07, BENN-08, BENN-09, and BENN-10) and the Kemptown Community Park site (BENN-03), all in Bennett Creek. Percent embeddedness was high at all other sites (> 50%); previous years' studies show this is a continuing problem. Aquatic biota, particularly benthic macroinvertebrates, need the spaces between and beneath gravel and cobble substrate for attachment sites, feeding areas, and as shelter from predation. When large quantities of silt and sediment fill in these spaces, they can smother biota and limit their ability to survive in an area. BENN-05, which previously had no riparian buffer, due to the areas on both banks being utilized for pasture, now has between 15 and 50 meters of riparian buffer on both banks. Stream fencing was erected to keep cattle out of the stream and the buffers were planted with trees in 2008. Riparian buffers serve multiple functions that are crucial to stream health, including: bank stabilization, slowing of runoff and prevention of flashy flows during storms, addition of large woody debris and leaf matter for habitat and food, nutrient uptake, and providing shade and modulating water tempera-

tures. Overall habitat quality was very good at BENN-03, BENN-07, BENN-08, BENN-09, and BENN-10.

7.2.3 Biological Assessment

As discussed in Section 5.1.2, biological assessment methods employed current MBSS fish and benthic protocols and IBIs. Benthic sampling was conducted in the spring and fish were sampled in the summer. The MBSS IBI scores are divided into four classes ranging from Very Poor to Good (Table 7-2). A summary of benthic and fish IBI scores and classes for each sampled site is provided in Table 7-3**.**

Table 7-2. Scoring classes for the Index of Biotic Integrity used by the MBSS indices

Class	Range
Good	4.0 – 5.0
Fair	3.0-3.9
Poor	2.0-2.9
Very Poor	1.0-1.9

Table 7-3. Summary of 2009 results using the MBSS 2005 IBIs

Station	Benthic IBI Score	Benthic IBI Rating	Fish IBI Score	Fish IBI Rating
BALL-04	3.00	Fair	4.67	Good
BALL-07	2.25	Poor	4.67	Good
BENN-03	3.75	Fair	3.67	Fair
BENN-05	2.75	Poor	3.67	Fair
LING-18	3.00	Fair	1.67	Very Poor

The IBI ratings for benthic macroinvertebrate and fish communities yielded different ratings of stream condition at all sites. The disparity between benthic IBI scores and fish IBI scores may be explained by physical factors. BALL-04, BALL-07, and BENN-05 are highly embedded, with heavily eroded streambanks, and have marginal-to-poor quality epifaunal substrate for use by stream insects. These sites are characterized by large pools and slow deep runs. They have limited cobble/gravel substrate, which along with rootwads and woody debris, are the preferred shelter types and attachment sites for benthic macroinvertebrates. This limits the available habitat for many benthic macroinvertebrate species, yet provides ideal habitat for a variety of fish. Several large pools/deep holes and woody debris provided the necessary protection and cover for fish. This allowed for sites to be rated Poor or Fair with the BIBI, but Good with the FIBI. In the case of LING-18, the shallow water levels allow for healthy benthic macroinvertebrate populations but are limiting for fish.

7.3 COUNTYWIDE STREAM ASSESSMENT

As noted in Section 5.1.5, a countywide stream assessment is a core component of the County's three-pronged STREAM program. The Frederick County Stream Survey (FCSS) is a probability-based survey (with random site selection) using rapid benthic macroinvertebrate and physical habitat assessment methods to provide information on the County's streams at a finer scale than is currently available through the MBSS. The following sections summarize the first two rounds of monitoring that began in spring 2008 and continued in spring 2009.

7.3.1 Survey Design

The following is a summary of the first two years of the FCSS, which will support estimation of conditions throughout Frederick County and within each of the County's 20 watersheds.

The FCSS has been modeled after the statewide MBSS to leverage MBSS reference conditions, IBIs, stressor identification methods, and other tools. MBSS methods are being used to collect rapid benthic macroinvertebrate, physical habitat, and water quality data. Because of resource constraints, fish community surveys will not be conducted in the Countywide survey; however, the County will continue to use fish community assessments as an important tool during other stream sampling efforts.

Analysis of MBSS data indicates that a minimum of 10 sites must be sampled in each watershed to obtain estimates of stream condition with adequate precision. Therefore, the County's survey includes the random selection and sampling of 200 sites stratified across the County's 20 watershed management units. The survey will sample 50 sites per year for four years to complete the countywide assessment, which will have the benefit of minimizing the influence of wet and dry years on the survey results. This four-year assessment cycle will provide a snapshot of stream condition in Frederick County that may be repeated on a regular schedule into the future. One or more years between cycles may be reserved for special studies.

The survey uses a sample frame that consists of the Frederick County portion of the MBSS 1:100,000-scale stream network. The MBSS does not sample streams larger than fourth-order because they are generally not wadeable. Therefore, stream segments considered by MBSS to be too large to sample are also excluded from the Countywide survey.

Once the sample frame was developed, survey locations were randomly assigned along the stream network using a FORTRAN-based program. Site selection within a watershed included the simple random selection of the 10 target sites plus the selection of 140 "extra sites" for a total of 150 sites, selected using GIS. Extra sites were selected to ensure that a sufficient number of sites remained available for sampling after permission denials, and unsampleable sites were removed from consideration. The random sample points chosen in GIS were designated as the midpoint of the 75-meter sampling segment in the field. Sites selected less than 75 meters from another randomly-selected site (both upstream and downstream) were eliminated to avoid overlap. The order in which sites were randomly picked was included in the attribute data to maintain the random nature of the site selection process.

The FCSS obtains landowner permission to access and sample all stream sites. Building upon procedures developed for the MBSS and previous Frederick County monitoring programs, the randomly selected site picks are used in conjunction with landowner information obtained from the current Maryland Property View GIS data product to develop a mailing list. Permission letters, along with a postage-paid reply postcard and an informational page of Frequently Asked Questions, are then sent to each property owner needed to access individual sites. Landowner responses, both granting and denying access, are compiled and recorded in the landowner database. Often, permission must be obtained from multiple landowners to access a single site and follow-up phone calls are made as necessary to obtain remaining permissions needed for individual sites. Once sufficient permissions have been obtained within a watershed to sample the target number of sites, two to three sites per year of the survey, field crews will visit the sites in the order they were randomly selected. If sites are found to be unsampleable, then crews proceed to the next site on the list for which permission has been granted.

Field surveys are conducted using the MBSS Round Three field methods described by Stranko et al. (2007) and modified as follows. The FCSS makes a single visit to each site during the Spring Index Period (March through April) to collect a benthic macroinvertebrate sample, measure in-situ water quality, measure stream discharge, collect an aqueous grab sample, and record all spring and summer MBSS habitat, index period and vernal pool data. Temperature logs, stream gradient, number of anodes and stream width, and summer fauna data are not recorded as part of the FCSS. Water samples are analyzed in the laboratory using MBSS laboratory methods for the parameters listed in Table 7-4.

Table 7-4. Analytical parameters, using MBSS protocols, for FCSS water samples
Nitrite Nitrogen
Nitrite Nitrogen + Nitrate Nitrogen
Ammonia
Total Nitrogen
Orthophosphate
Total Phosphorus
Dissolved Organic Carbon
Turbidity

Benthic macroinvertebrate samples collected during the FCSS are processed according to protocols in the MBSS benthic laboratory manual (Boward and Friedman 2000). Namely, identification of a 100-organism subsample to the genus taxonomic level, with the exception of oligochaete worms, which are identified to the family level. Benthic identification data are entered by laboratory staff into an Access database containing tolerance values and other ancillary data to streamline data management and enhance quality control.

Reporting of survey data occurs at the conclusion of each sampling year following data analysis and calculation of Benthic IBI scores. Because the survey design spreads the 10 sample points targeted for each watershed over a four-year period to minimize variation in weather, area-wide estimates at the watershed level will not be available until after the fourth year. However, an

area-wide estimate is possible for the County after the first year, as well as other areas that have a minimum of 10 sampling sites (e.g., basin level estimates for the Upper Monocacy and Lower Monocacy). Estimates for smaller areas (e.g., groups of watersheds), and more precise estimates for larger areas can be made as additional sampling data become available following the second and third sampling years. Reports will focus on presenting information in a concise manner that can be readily understood by a broad, non-technical audience to maximize the utility of the survey.

7.3.2 Pilot Study for the Countywide Stream Assessment

A pilot survey in the high priority Bennett and Catoctin Creek watersheds was conducted in 2007 to help develop, test, and refine methods for the full FCSS. A report compiling those results was completed in January 2009 (Versar 2009a). Lessons learned from the pilot were incorporated into the 2008 initiation of the Countywide survey and results were used to support a watershed restoration planning study in Bennett Creek watershed.

The initial sample frame for the countywide survey was based on Frederick County's stream layer, which had been digitized at a scale of 1:2,400 from aerial photographs flown in 2000. This stream layer was further limited to those portions that were considered to be wadeable by the MBSS by eliminating segments of stream matching those that were fifth order or larger on the MBSS 1:100,000 stream layer. Using the random site generation routine, permission process, and sampling methods described above, field crews sampled 50 sites Countywide.

7.3.2.1 Sampling Years 2008-2009

Beginning with year 2008, the MBSS 1:100,000 stream layer was used as the sample frame for the FCSS. Benthic sample data were used to calculate benthic IBI scores for each site (Table O-1 in Appendix O; Figure 7-2). The average benthic IBI score for the County for the first two years of the Survey was 2.97 (Poor). Scores were spread throughout the County, with 9% of stream miles scoring Very Poor, 32% scoring Poor, 46% scoring Fair, and only 13% of stream miles scoring Good.

Grab samples were collected for laboratory analysis of water quality parameters at each of the 50 monitoring stations (Table O-2). Average total nitrogen for the County was 3.44 mg/l. Total nitrogen concentration exceeded the MBSS's "High" water quality threshold of 7.0 mg/l (Southerland et al. 2005) for 12% of the stream miles in the County. Figure 7-3 shows the distribution of Total Nitrogen scores throughout the County. Thirty-six percent of stream miles were Low for Total Nitrogen and the remaining 52% were in the middle range.

Average total phosphorus for the County was 0.037 mg/l. Total phosphorus concentrations exceeded the MBSS's "High" water quality threshold of 0.070 mg/l for 13% of stream miles in the County. Figure 7-4 depicts the distribution of Total Phosphorus scores throughout the County. Forty-nine percent of stream miles were Low for Total Phosphorus and the remaining 38% were in the middle range. See Table O-2 in Appendix O for these parameters, as well as others measured, by site.

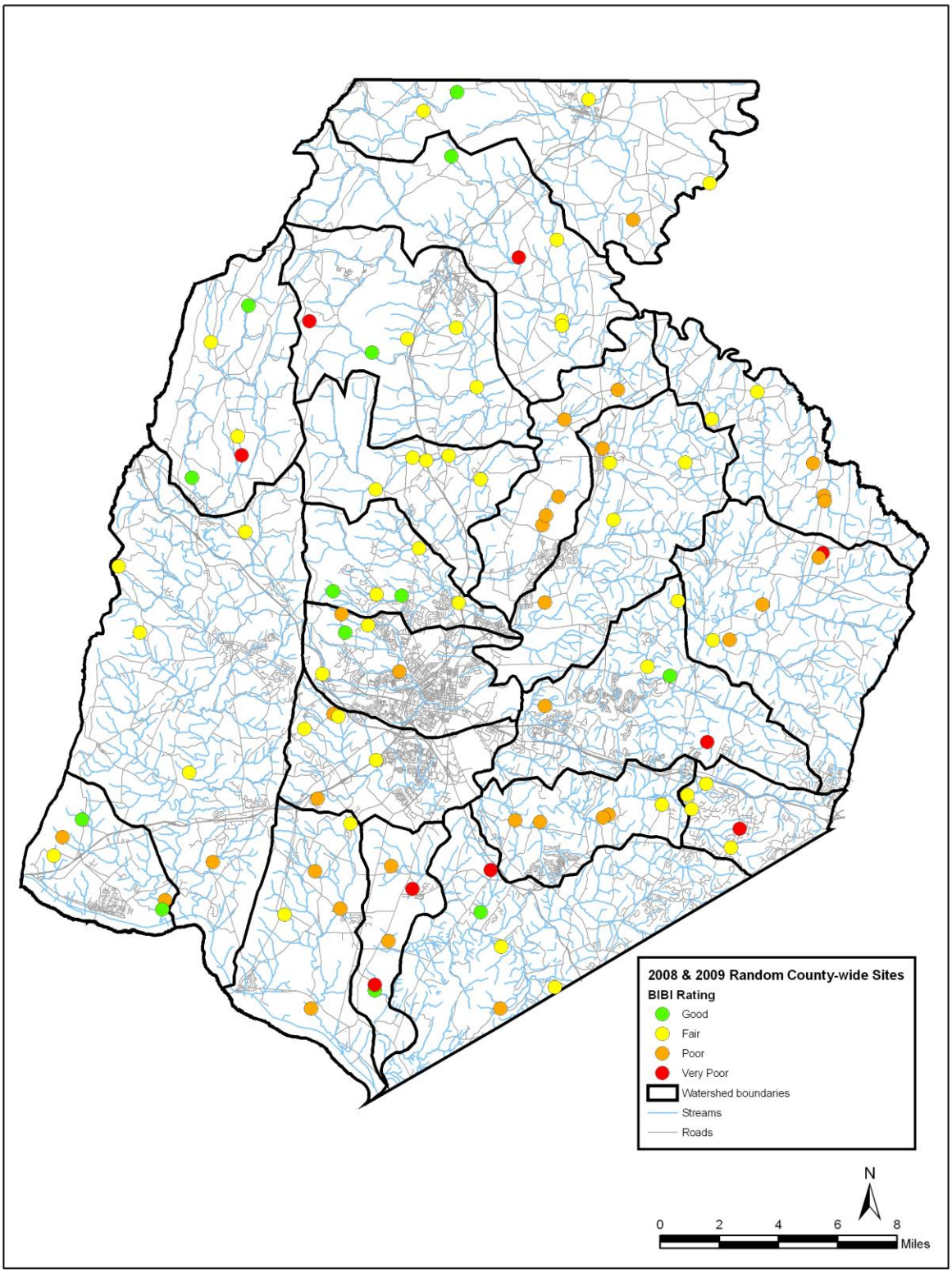

Figure 7-2. Map of Frederick County with 2008 and 2009 FCSS monitoring sites and benthic IBI scores

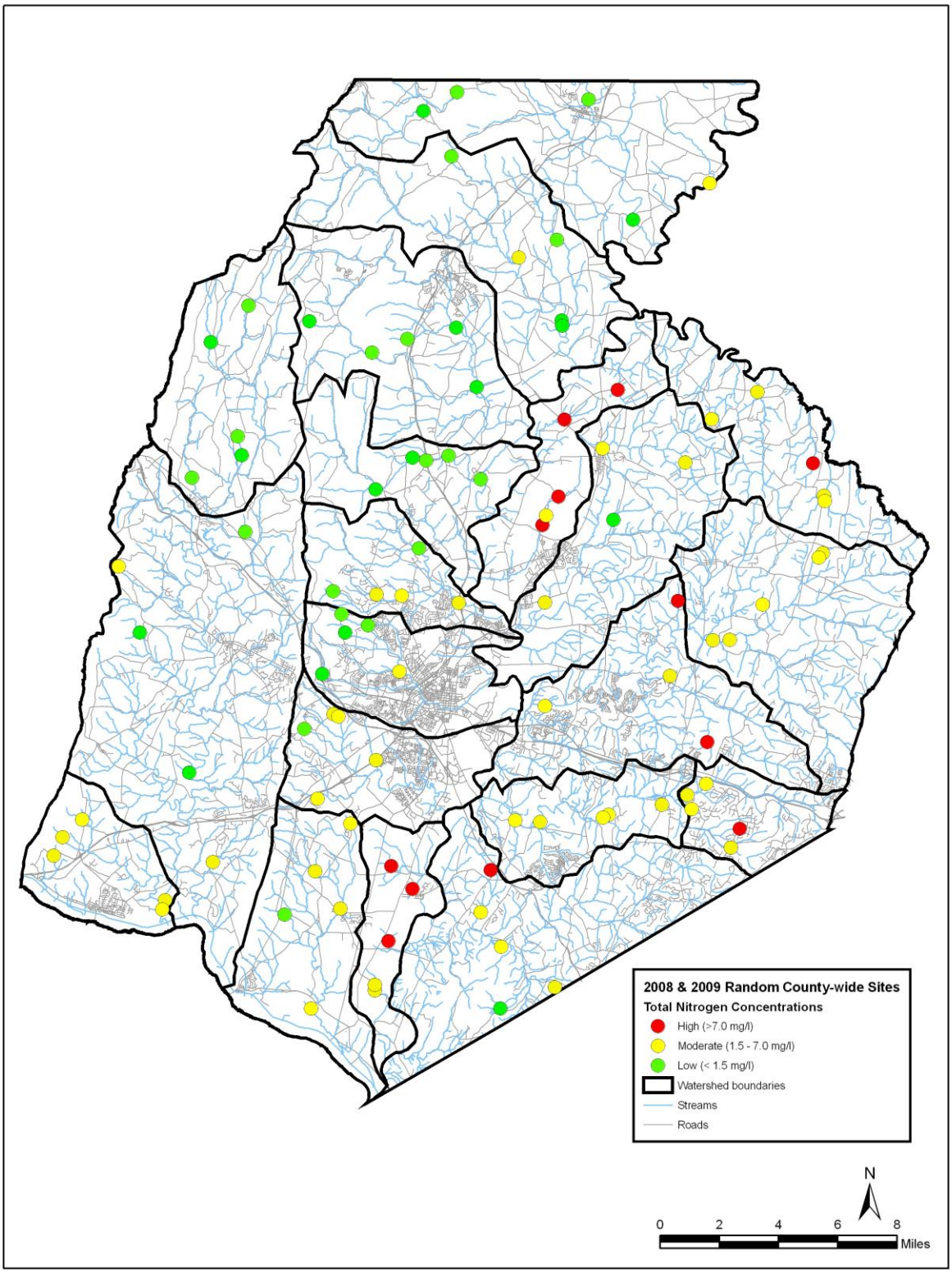

Figure 7-3. Map of Frederick County with 2008 and 2009 FCSS monitoring sites and Total Nitrogen concentrations (mg/l)

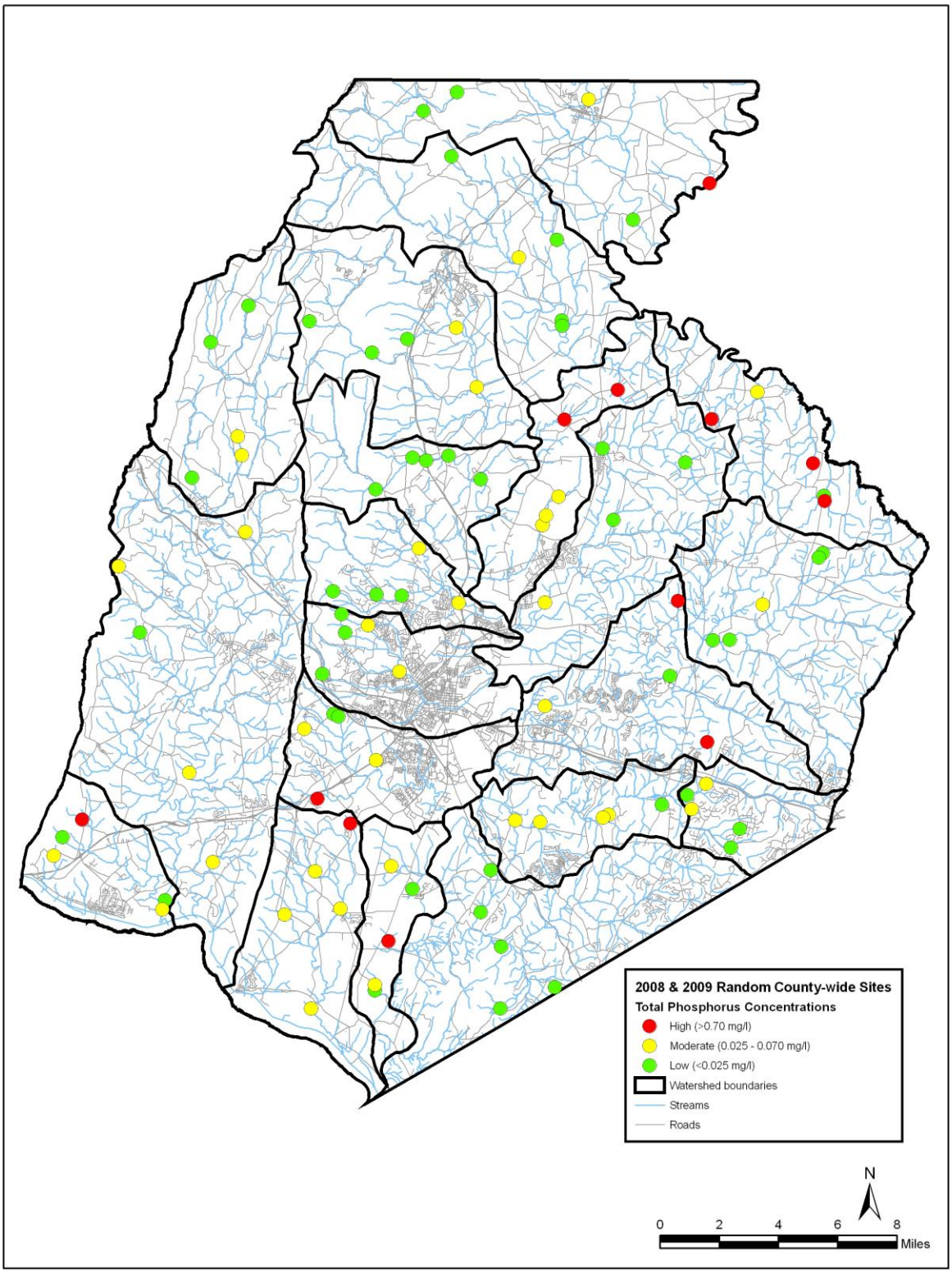

Figure 7-4. Map of Frederick County with 2008 and 2009 FCSS monitoring sites and Total Phosphorus concentrations (mg/l)

7.4 IMPLEMENTATION AND TRACKING OF RESTORATION EFFORTS IN FREDERICK COUNTY

Watershed restoration projects are driven by regulatory and voluntary requirements. The purpose of these projects is to reduce pollution to water bodies and to provide ancillary benefits, such as improving habitat. This section describes the main regulatory drivers of restoration projects in Frederick County, types of pollutant reductions, circumstances under which the County counts projects towards NPDES permit requirements, and the strategy for project implementation.

The County hopes to develop an agreement with MDE that will allow it to use land conservation and market-based trades with agricultural Best Management Practices as tools for achieving restoration goals, consistent with EPA and Bay Program Models. These types of BMPs rely on the best ratios of benefit to cost and take into account the exurban nature of Frederick County, where developed and agricultural areas coexist in the same catchments, and where a legacy of agriculture poses issues in developed and developing areas. These BMPs also provide one tool in the toolbox for the County to use to prevent additional impacts to the watershed by preventing the conversion of agricultural and forest land to exurban development.

7.4.1 Regulations

In Frederick County, there are currently five main regulatory drivers that influence restoration efforts. The primary regulation driving restoration projects is the NPDES Program of the Clean Water Act, addressed in this Annual Report. Under the County's NPDES permit for its municipal separate storm sewer system (MS4), it is required to reduce discharges to the MS4 in urban areas. The County is also required to restore areas degraded by urban stormwater and to treat 10% of the untreated urban impervious areas.

Total Maximum Daily Load (TMDL) regulations of the CWA require sources of pollutants in impaired water bodies to limit their releases. Earlier TMDLs, like those for sediment and phosphorus for Lake Linganore, do not set specific discharge limits for MS4s. They do, however, allocate a load to nonpoint non-agricultural sources within the MS4. More recent TMDLs explicitly set loads for the MS4s. A number of the more recent TMDLs have been drafted and/or approved for watersheds within the County. Thus, it is in the best interest of the County to track the pollutant reductions associated with its restoration projects.

Safe Drinking Water Act regulations set higher standards for water bodies that are used as a public drinking water supply. The Linganore TMDL is more stringent because the water body is used for this purpose. Restoration activities are being targeted in the Linganore area and are carefully tracked for this reason.

The Chesapeake Bay 2000 Agreement (C2K) is a voluntary agreement among bay states and has been signed by the Board of County Commissioners of Frederick County. C2K calls for voluntary reductions of bay pollutants and increased restoration activities such as riparian buffer plantings.

House Bill 1141 (HB1141) requires the development of water resource elements in Comprehensive Plans to protect sensitive resources. Frederick County developed a Water Resources Plan that is a stand-alone, technical document. It provides a detailed presentation of the County's water resources limitations, challenges, and solutions. It is summarized in the County's most recent Comprehensive Plan update in the "Assessing Our Water Resources" chapter. The Water Resources Plan is divided into three components: Drinking Water Assessment, Wastewater Assessment, and Managing Stormwater and Non-point Source Pollution.

7.4.2 Tracking Pollutants

Frederick County Government has focused its restoration tracking on the following:

- **Nutrient Reductions:** Phosphorus is the limiting nutrient in eutrophic Lake Linganore and is the subject of a TMDL. Other areas in the county are listed as impaired for nutrients.Draft TMDLs for phosphorus will be developed for most watersheds in Frederick County in 2010. Phosphorus and nitrogen reductions from all restoration projects are quantified and tracked.
- **Sediment Reductions:** Lake Linganore, the Lower Monocacy, Catoctin Creek, and Double Pipe Creek have TMDLs for sediment. A draft TMDL has been submitted to EPA for the Upper Monocacy. Sediment reductions are tracked for all projects with the caveat that these estimates are crude and can be off by an order of magnitude or more depending on site conditions.
- **Fecal Bacteria:** Double Pipe Creek and the Upper and Lower Monocacy River Watersheds have recently been regulated with TMDLs for fecal coliform. There are not good numbers at the moment for BMP reductions of coliform. Frederick County will be working to implement these TMDLs over time.
- **Impervious Area Reductions:** As required by its NPDES permit, the County has calculated the number of acres of untreated stormwater from urban areas and must provide for the treatment of 10%. The County's 2003 estimate remains unchanged, with 6,725 acres of untreated impervious acres in Frederick County; hence, the County's 10 percent treatment goal is 672 acres.
- **BMP Statistics:** General statistics on BMP implementation include BMP type and size/ quantity of BMP implemented (e.g., acres, linear feet, or some other metric). These metrics are especially helpful in meeting the C2K agreement and calculating pollutant reductions for other requirements. Estimates of BMP pollutant removal efficiency, usually taken from documents prepared by the Chesapeake Bay Program, are used to calculate removals by sources and are tracked by the County (Chesapeake Bay Program 2003a, 2003b, 2005; Langland and Cronin 2003; Maryland Department of Natural Resources 2003; Shenk 2003; U.S. EPA 1999). Note: Riparian Buffer projects treat 3 acres for every acre planted when drainage size appropriate. Rain Gardens treat first flush of drainage areas for water quality. Street Sweeping is only counted for areas swept and not the drainage areas. Stream Restoration counts drainage of land immediately adjacent to stream but gets most reductions (unquantified) from instream erosion control.

As described in section 7.3, the County has developed and is implementing a countywide probability-based stream monitoring program to evaluate watershed conditions on the whole, correlate these conditions to stressors, integrate with the Restoration/Retrofit Assessments to correct the stressors, and monitor for improvements on the watershed basis as well as on an individual project basis. The County will be evaluating metrics over time to use as report-card type indicators of stream and watershed conditions for the public to review. The County is working to develop several key indicators that would be used in watershed reporting that would also include imperviousness data to be calculated using planimetrics and other proxies of watershed health. The end result would be both project-specific and watershed-specific tracking of restoration project success. These efforts are in early development stages and will take several years to fully implement.

Biological impairments are relatively simple to track but very difficult to relate to stressors. The Maryland Biological Stream Survey is developing stressor identification tools that will correlate to biological impairments. These tools, largely based on habitat analyses, will be tracked as part of the monitoring of projects designed to improve biological conditions in streams.

In 2005, some restoration projects were not counted toward NPDES requirements because they were federally funded. Since that time, discussions with Montgomery and Baltimore Counties, which count federally-funded projects, have led Frederick County to count these projects with the understanding that the primary purpose of federally funded projects is not to meet NPDES requirements.

The County is negotiating with MDE on the use of additional BMPs like land conservation and agricultural BMP trading that would result in significantly more treatment and benefits for costs expended. The County is also looking at counting its other efforts in redevelopment and forest management in the context of this tracking program.

7.4.3 Restoration Projects by Type

Frederick County Government has taken a role in a wide variety of watershed restoration efforts, which can be organized both by watershed and by project type. Table 7-5 provides an overview of projects by type as described below. Section 7.5 will review the progress on meeting recommendations from the individual Watershed Assessments, and will provide more detail on each restoration project by watershed.

- **Frederick County NPDES Capital Improvement Program (CIP) Projects** are conducted through the County's CIP program and are conducted primarily as a result of NPDES requirements. These projects are closely monitored for success and cost/ benefit and generally monitor actual pollutant removal and/or other project goals. The projects must cost over $100,000 and impact county property or county-owned infra-structure. These projects have significant community involvement in the public meeting phase.
- **Frederick County Community Restoration Projects (CCRP)** count towards NPDES goals. These projects are sponsored by Frederick County Government. These projects rely on calculated BMP efficiencies to determine pollutant reduction. They usually have significant

community involvement, such as planting events. They are not funded by the CIP and therefore are not subject to the restrictions of CIP funding. Funding may be internal or external. These projects have Frederick County as a lead partner. Some of these projects are already reported for C2K implementation; those are marked.

- **Monocacy & Catoctin Watershed Alliance (MCWA) Partnership Projects** may include participation and/or facilitation by Frederick County Government, but the lead partner is outside the County government. Frederick County is counting its efforts with these projects towards its NPDES restoration goals, but for the purpose of accounting with C2K, the County asks MDE not to record "credit" for the projects.

7.4.4 Implementation Strategy and Timeline

There are a number of current and planned watershed restoration projects taking place within Frederick County that are intended to reduce nitrogen, phosphorus, sediment, and effective impervious area. Table 7-5 provides a status and implementation year for each project. All of the projects in the table are funded and are at minimum "in progress." As noted, some projects have been completed.

7.5 WATERSHED ASSESSMENT AND RESTORATION

As required by the permit, the County conducted Watershed Assessments in three watersheds by the end of its permit cycle: Ballenger Creek, Bush Creek, and Lower Linganore Creek. The County will propose including the Bennett Creek watershed as its next priority for restoration and protection in its next NPDES MS4 permit. In good faith, the County has moved forward with activities in this watershed. As mentioned in prior Annual Reports, the County identifies opportunities for watershed restoration largely through its Stormwater Retrofit and Stream Restoration (R/R) Assessments conducted on a watershed-by-watershed basis. To date, R/R Assessments have been completed in Lower Bush Creek, Ballenger Creek, Linganore Creek, and Bennett Creek Watersheds. The following sections detail the recommendations of the watershed assessments and the actions that have been taken on behalf of watershed restoration. The projects shown in Table 7-5 are arranged by type of project as described in Section 7.4. Within the narrative section, restoration projects are identified by their project number as indicated in Table 7-5 and described in more detail.

Note that the acreages and treatment numbers are modified each year to provide actual estimates from project monitoring and implementation; for example, Backyard Buffer numbers reported in 2007 were adjusted to account for mortality. MDE's response to the 2008 Annual Report asked why the mortality for this Best Management Practice is so high. This figure is an assumed mortality for our accounting purposes where we do not have data on implementation; most programs assume 20% mortality but these programs have mechanisms to follow-up on planting efforts. Our experience has been that planting efforts with no follow-up average about 50% mortality.

Table 7-5. Current, planned, and completed watershed restoration projects within Frederick County

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
Frederick County NPDES Capital Improvement Projects (CIPs)									
CIP-3	Ballenger Creek Elementary School	Stream Restoration	Ballenger Creek	Complete	2007	12.10	2.12	1,542.75	4.00
		Urban Forest Buffer				12.85	0.85	343.56	
CIP-4	Urbana High School	Stormwater Retrofit (LID)	Upper Bush Creek/Bennett Creek	Complete	2007	5.42	0.81	231.58	2.83
		SWM Wetland			2009	35.03	5.63	0.00	18.30
		Tree Planting			2009	12.85	1.58	284.66	3.00
CIP-45	Pinecliff Park	Stream Restoration	Lower Linganore Creek	In Progress	2010	18.60	3.26	2,371.50	46.40
		Urban Forest Buffer							
CIP-46	Public Safety Training Facility	SWM Nonstructural	Lower Linganore Creek	In Progress	2010	28.71	4.32	1,227.48	15.00
CIP-190	Urbana Highway Ops Satellite Yard	SWM Infiltration	Bennett Creek	In Progress	2010	13.39	2.32	944.34	5.77
CIP-206	Brunswick Library	Surface Sand Filter	Catoctin Creek	In Progress		3.87	0.67	273.32	1.67
CIP-209	Citizens Care & Rehabilitation Center/Montevue Home	SWM Wet Pond	Carroll Creek	In Progress		29.19	7.58	3,088.34	25.16
					SUBTOTAL	**172.00**	**29.13**	**10,307.54**	**122.13**
Frederick County Community Restoration Projects									
CCRP-5	Libertytown Elementary School	Rain Garden	Upper Linganore Creek	Complete	2006	0.48	0.07	20.46	0.25
CCRP-6	Liberty Village Cohousing Community	Rain Garden	Lower Linganore Creek	Complete	2006	0.37	0.13	30.00	0.25
		Urban Forest Buffer				41.98	1.89	769.57	8.40
		Urban Grass Buffer				31.32	2.02	824.54	9.00

Table 7-5. (Continued)

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
CCRP-7	St. Peter the Apostle Roman Catholic Church	Urban Forest Buffer	Lower Linganore Creek	Complete	2006	7.50	0.34	137.42	1.50
		Urban Grass Buffer				0.63	0.04	16.49	0.18
CCRP-8	Backyard Buffer	Urban Forest Buffer	Countywide	Ongoing		242.88	10.92	4,452.54	48.60
CCRP-11	Windsor Knolls Middle School	Rain Garden	Bennett Creek	Complete	2005-2010	0.48	0.07	20.46	0.25
		SWM Wetland		Complete		26.03	4.19	0.00	13.60
		Tree Planting		In Progress		115.66	14.18	2,561.98	27.00
		Urban Riparian Forest Buffer		Complete		44.98	2.02	824.54	9.00
CCRP-13	Kemptown Elementary School	Rain Garden	Bennett Creek	Complete	2005-2008	0.48	0.07	20.46	0.25
		Urban Forest Buffer				6.75	0.30	123.68	1.35
CCRP-18	Septic Upgrades	Septic Denitrification (MDR)	Countywide	Complete		27.49	0.00	0.00	35.00
CCRP-55	Libertytown Park	Rain Garden	Upper Linganore Creek	Complete	2006	2.10	0.32	89.85	1.10
		Tree Planting				1.41	0.17	31.31	0.33
		Urban Forest Buffer				96.44	4.34	1,768.06	19.30
		Urban Grass Buffer				28.19	1.82	742.09	8.10
CCRP-57	Fountainrock Park	Wetland	Glade Creek	Complete	2009	1.16	0.30	122.75	1.00
CCRP-62	Monocacy Elementary School	Urban Grass Buffer	Tuscarora Creek	Complete	2007	0.87	0.06	22.90	0.25
CCRP-64	Thurmont Middle School	Urban Forest Buffer	Hunting Creek	Complete	2004	0.30	0.01	5.50	0.06
CCRP-69	Utica Park	Urban Forest Buffer	Fishing Creek	Complete	2007	44.98	2.02	824.54	9.00
CCRP-71	Mt. Airy Village Gate Park	Urban Forest Buffer	Upper Linganore Creek	Complete	2007	40.63	1.83	744.84	8.13

Table 7-5. (Continued)

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
CCRP-72	Mt. Airy East West Park	Urban Forest Buffer	Upper Linganore Creek	Complete	2007	50.55	5.27	1,073.87	11.40
CCRP-80	Deer Crossing Elementary School	Rain Garden	Lower Linganore Creek	Complete	2007	0.76	0.11	32.41	0.40
CCRP-131	Cooperative Extension Building	Tree Planting	Carroll Creek	Complete		2.14	0.26	47.44	0.50
CCRP-137	Governor Thomas Johnson High School	Rain Garden	Carroll Creek	Complete	2005	0.24	0.21	23.48	0.50
CCRP-138	Governor Thomas Johnson Middle School	Rain Garden	Carroll Creek	Complete	2005	0.48	0.07	20.46	0.25
		Urban Forest Buffer				1.50	0.07	27.48	0.30
CCRP-139	West Frederick Middle School	Urban Forest Buffer	Carroll Creek	Complete	2005	17.99	0.81	329.82	3.60
CCRP-140	Thurmont Elementary School	Rain Garden	Hunting Creek	Complete	2005	0.48	0.07	20.46	0.25
CCRP-142	Holly Hills HOA	Urban Forest Buffer	Lower Linganore Creek	Complete	2007	44.98	2.02	824.54	9.00
CCRP-143	Holly Hills Country Club	Urban Forest Buffer	Lower Linganore Creek	Complete	2007	52.47	2.36	961.97	10.50
CCRP-144	Pinecliff Park	Urban Forest Buffer	Lower Linganore Creek	Complete	2007	0.72	0.03	13.19	0.14
CCRP-145	Mt. Saint Mary's Run	Urban Forest Buffer	Toms Creek	Complete	2007	2.70	0.12	49.47	0.54

Table 7-5. (Continued)

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
CCRP-146	Mt. Airy Windy Ridge Park	Urban Forest Buffer	Lower Linganore Creek	Complete	2008	179.91	8.09	3,298.18	36.00
		Urban Grass Buffer				61.71	3.98	1,624.35	17.73
CCRP-148	Tuscarora Elementary School	Tree Planting	Ballenger Creek	Complete	2007	1.10	0.05	20.16	0.22
CCRP-150	Myersville Elementary School	Tree Planting	Catoctin Creek	Complete	2007	0.04	0.01	0.95	0.01
CCRP-152	Wolfsville Elementary School	Tree Planting	Catoctin Creek	Complete	2008	0.77	0.09	17.08	0.18
CCRP-153	Walkersville High and Elementary Schools	Tree Planting	Israel Creek	Complete	2008	1.71	0.21	37.96	0.40
CCRP-155	Up County Family Support Center	Rain Garden	Toms Creek	Complete	2008	0.005	0.004	0.47	0.01
CCRP-157	Emmitsburg Elementary School	Rain Garden	Toms Creek	Complete	2009	0.07	0.06	7.04	0.15
		Urban Grass Buffer		Complete		4.65	0.21	85.20	0.93
CCRP-159	Urbana Middle School	Tree Planting	Bennett Creek	Complete	2009	1.07	0.13	23.72	0.25
CCRP-161	Valley Elementary School	Tree Planting	Catoctin Creek	Complete	2009	18.29	2.24	405.17	4.27
		Wetland			2008	0.62	0.16	65.92	0.54
CCRP-191	Kemptown Park	SWM Bioretention	Bennett Creek	Complete	2009	0.61	0.13	47.26	0.42
CCRP-192	Street Sweeping Highway Ops - Streets and Bridges 2009	Street Sweeping Vacuum Annual	Countywide	Ongoing		0.00	0.00	0.00	430.31

Table 7-5. (Continued)

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
CCRP-195	Urbana Community Park	Riparian Forest Buffers (previously cropped, LU conversion)	Bennett Creek	Complete	2009	17.01	1.87	572.65	2.20
CCRP-198	Bar T Mountainside	Rain Garden	Bennett Creek	In Progress	2009-2010	0.96	0.14	40.92	0.50
		SWM Wetland		In Progress	2010	5.80	1.51	613.74	5.00
		Urban Riparian Forest Buffer		Complete	2009	82.24	5.55	2,261.61	28.80
CCRP-199	Worthington Manor Golf Course	SWM Wetland	Bennett Creek	In Progress	2010	21.58	5.60	2,283.11	18.60
		Urban Riparian Forest Buffer		In Progress	2010	71.96	3.24	1,319.27	14.40
CCRP-200	Middletown High School	Tree Planting	Catoctin Creek	Complete	2009	1.07	0.13	23.72	0.25
CCRP-201	Oakdale Elementary School	Tree Planting	Lower Linganore Creek	Complete	2009	0.04	0.01	0.95	0.01
CCRP-210	Urbana Elementary School	Bioretention/Bioswale	Bennett Creek	In Progress	2010	8.70	1.81	675.11	6.00
					SUBTOTAL	**1,418.00**	**93.75**	**31,003.11**	**806.45**
Monocacy & Catoctin Watershed Alliance (MCWA) Partnership Projects									
MCWA-14	Fred Archibald Sanctuary	Urban Forest Buffer	Lower Linganore Creek	Complete	2007	59.97	2.70	1,099.39	12.00
MCWA-17	Catoctin Mountain Park	Porous Pavement	Hunting Creek	Complete	2006	0.58	0.07	56.26	0.50
MCWA-26	Waterford Park	Urban Forest Buffer	Carroll Creek	Ongoing		92.45	4.16	1,694.90	18.50

Table 7-5. (Continued)

Project Number	Project Location	Project Type	Watershed	Project Status	Year of Completion	Reduction			
						Nitrogen (lbs/yr)	Phosphorus (lbs/yr)	Sediment/Total Suspended Solids (TSS) (lbs/yr)	Treated Impervious Area (acres)
MCWA-28	New Forest Society Grow Out Nursery	Urban Forest Buffer	Toms Creek	Complete	2007	3.86	0.47	85.40	0.90
MCWA-41	Little Catoctin Creek	Stream Restoration	Little Catoctin Creek	Complete	2007	105.60	18.48	13,464.00	20.00
MCWA-43	Thorpewood	SWM Nonstructural	Hunting Creek	Complete	2007	0.48	0.07	20.46	0.25
MCWA-48	Brook Hill United Methodist Church	Rain Garden	Tuscarora Creek	Complete	2007	0.24	0.21	23.48	0.50
MCWA-66	Carroll Creek	Stream Restoration	Carroll Creek	Complete	2007	4.00	0.70	510.00	0.23
MCWA-77	State Highway Administration Stream Restoration - TEP	Stream Restoration	Potomac Direct	Complete	2009	26.00	4.55	3,315.00	1.94
MCWA-79	Cloverhill	Urban Forest Buffer	Tuscarora Creek	Complete	2006	31.48	1.42	577.18	6.30
					SUBTOTAL	**324.66**	**32.82**	**20,846.07**	**61.12**
					TOTAL	**1,914.66**	**155.70**	**62,156.71**	**989.7**

7.5.1 Lower Bush Creek

7.5.1.1 Watershed Assessment in Lower Bush Creek Watershed

Frederick County completed a baseline watershed assessment for Lower Bush Creek in 2001 (Roth et al. 2001a). A number of recommendations to improve water quality were made in this report, and the County continues its efforts to implement these recommendations and other initiatives to improve watershed conditions in Lower Bush Creek. Programmatic actions that have been implemented include:

- The County continues to bolster its erosion and sediment control program by coordinating with MDE on program improvements.
- The Monocacy & Catoctin Watershed Alliance developed an educational brochure in 2006, and education workshops with homeowners' associations and other organizations have been conducted and planned in high growth areas.
- Staff continued to review project plans and enforce requirements for stormwater management through the Division of Permitting and Development Review.
- Versar, Inc. continued annual monitoring of stream stations in Peter Pan Run and periodic monitoring in Lower Bush Creek.
- Through a National Fish and Wildlife Foundation grant, WMS staff developed a GIS-based "House Calls" program used to discuss opportunities for BMPs.

7.5.1.2 Implementation of Restoration Efforts in Lower Bush Creek Watershed

The County continued its involvement with watershed restoration projects within the Lower Bush Creek watershed. These efforts, summarized below, build upon the existing work within the watershed conducted by the County and other organizations. An assessment of retrofit and restoration opportunities was conducted in the Lower Bush Creek watershed (Perot et al. 2003) and provides guidance for restoration measures.

- Stormwater Retrofit/Stream Restoration (R/R) Assessment

An R/R assessment was completed in August 2003 for the Lower Bush Creek watershed (Perot et al. 2003). The study identified and evaluated specific opportunities for improving stormwater management controls and stream restoration to improve and protect water quality and stream conditions in the Lower Bush Creek watershed. A public meeting was held in February 2003 at Urbana High School to provide an overview of the County's study, identify public concerns, and solicit public input for identification of restoration and SWM opportunities.

The assessment identified twenty-four candidate project sites that could be used to improve watershed conditions. Six sites involved both stream restoration and stormwater management retrofits; seventeen involved just stream restoration; and one involved just stormwater management retrofits.

The County considered its consultant's recommendations as a preliminary prioritization and continued to further refine the priorities, selecting from among these candidates based on additional factors and priorities that would influence successful implementation. The County's selection process considered additional information, ownership, landowner cooperation, and additional project constraints to further refine the project approach and design and to determine whether additional action was warranted for each high priority candidate site.

- CIP Project - Urbana High School LID Retrofit (CIP-4)

DPW used County General Funds from the Capital Improvement Program (CIP) budget for the Lower Bush Creek watershed to design and install a Low-Impact Development (LID) retrofit project at the Urbana High School. The goals of the project were to reduce untreated impervious area and to improve water quality. Project design was completed by Tetra Tech, Inc., and installation was completed by Environmental Quality Resources (EQR) in summer 2007. The project installed rain gardens in the school's courtyard to treat runoff from the courtyard and roof. The project also includes a bioretention area to treat water from the school's bus lot that enters through curb cuts. The project was modified in 2009 to improve drainage in the rain gardens in the courtyard and to add additional treatment using porous pavers.

The project treats 2.83 acres for water quality from the first flush of pollution to about 0.8 inches of rainfall.

The school administrators and teachers were very excited about the project, and Biology students helped to pick the plants for the rain garden and bioretention areas. They also provided feedback on the project as a whole and helped the engineer to shape the facilities to minimize disturbance to the flow of traffic at the school. The students were particularly interested in why the project cost so much.

The effectiveness of the retrofit is being assessed by comparing "pre-retrofit" pollutant data to "post-retrofit" data. Additionally, "post-retrofit" data from the portion of the collection system undergoing retrofit will be compared to a second, "control" site that drains another portion of the school parking area. Both sites are stormwater outfalls that discharge stormwater into the dry detention facility downstream of the proposed retrofit. Versar monitored five "pre-retrofit" storm events – four in fall 2006 and one in spring 2007. Five "post-retrofit" storm events were monitored – three in 2008 and two in 2009. All samples were collected by automated sampler and were analyzed for nitrate and nitrite, total Kjeldahl nitrogen (TKN), total phosphorus, copper, zinc, and total suspended solids concentration. Three composite samples were collected at each sampling site corresponding to the rising, peak, and falling limbs of the storm hydrograph. Additionally, manual "first-flush" grabs of storm water effluent were collected at each point within the first 30 minutes of storm event inception to determine concentrations of oil and grease and total petroleum hydrocarbons (TPH).

7.5.2 Ballenger Creek

7.5.2.1 Watershed Assessment in Ballenger Creek

Frederick County continued to implement recommendations from the previously completed Watershed Assessment of Ballenger Creek (Roth et al. 2001b). Actions that have been implemented include:

- Programmatic Opportunities

  – Form County NPDES management committee. Involving multiple Divisions, the County has developed additional protection of water resources through implementation of HB1141 and TMDL regulations, which will result in a water resources element in the Comprehensive Plan. This element includes resources that are protected by NPDES MS4 permits. Additionally, staff developed a Green Infrastructure concept to meet watershed restoration goals while identifying systems with designated uses that support high-value natural resources. Green Infrastructure has been included as a priority in the Board of County Commissioner's Strategic Plan, the County's Sustainability Plan, and the draft Comprehensive Plan. It is also a priority for the internal Sustainability Task Force and the Sustainability Commission. Other efforts to promote the Green Infrastructure concept include meeting with local, state, and federal entities as well as staff trainings as discussed in Table 6-5 in Section 6.5. Staff has also developed a 319 funding proposal that includes Green Infrastructure (GI) language to align with EPA priorities for funding.

  – Develop Karst Ordinance/karst overlay zones. The County continues to track sinkhole formation and repair using a customized spatial database and uses the 2004 Maryland Geological Survey karst map showing karst prone areas. Development Review, Planning, and Engineering are now using MGS/USGS maps.

  – Targeting of Forest Resource Ordinance (FRO) plantings in riparian corridors. This has been accomplished, particularly in those areas with impairments for sediment and nutrients. The Board of County Commissioners has directed fee-in-lieu funds to be targeted to the Linganore Watershed; the Green Infrastructure effort will identify additional high-value areas for reforestation in riparian areas.

  – Develop Road Maintenance Program Improvement Plan. Reports continue to include explicit information about maintenance activities by highway district and DNR watershed. Reports have been amended to include data on the use of a new street sweeper (CCRP-192) including volume of material collected [per MDE's request as part of its review of the 2008 Annual Report].

- Site-Specific Opportunities

  – Construct a structural BMP demonstration project to research karst issues related to stormwater management. This has not proven to be practical at this time.

- Re-inspect three existing SWM structures during the watershed assessment. Completed in 2001.

- Stream Restoration: Ballenger Creek at Ballenger Creek Park. Completed in 2002.

- Stream Restoration: Ballenger Creek Park to the mouth of Ballenger Creek: Effort is part of trailway design.

- Stream Restoration: Ballenger Creek just upstream of New Design Road: Project completed at Elementary School in 2007 (CIP-3).

• Further Investigations at Specific Sites

- Stormwater impacts to groundwater in karst areas. In 2004, MGS/USGS developed maps with karst layers, which are now being used by Development Review, Planning, and Engineering.

- Scrapyard and truck repair facility. Completed in 2002.

• Long-Term Monitoring

- Continued monitoring of two stream stations on Ballenger Creek during 2009 to collect post-restoration data at the Ballenger Creek Elementary School site.

7.5.2.2 Implementation of Restoration Efforts in Ballenger Creek Watershed

The County has initiated a number of efforts to improve watershed conditions within Ballenger Creek. These efforts, summarized below, build upon the existing work within the watershed conducted by the County and other organizations.

• Stormwater Retrofit/Stream Restoration (R/R) Assessment

The R/R assessment, a study begun in 2004 to identify and evaluate specific opportunities for improved stormwater management controls and stream restoration in Ballenger Creek watershed, was completed in August 2005. Elements of this study (Perot et al. 2005) included a review of existing watershed information (including recent SCA stream walk data), map review to target efforts and solutions to the most promising areas, field investigations to refine proposed concepts for solutions, an April 2005 public workshop to solicit input from local stakeholders on problem areas and solution types, prioritization of opportunities, and development of a report containing recommendations and conceptual plans for the best watershed restoration opportunities. The assessment identified 74 candidate project sites that could be used to improve watershed conditions. Prioritization of these candidate projects identified 15 “Tier 1” sites that presented the best opportunities for the County’s CIP program; detailed fact sheets outlining conceptual plans were included in the report for these sites. The report also identified 14 “Tier 2” projects that would also present good opportunities for the County, and 45 “CR” sites that would be good opportunities for the County’s Community Restoration partners.

- CIP Project

  – Ballenger Creek Elementary School Stream Restoration (CIP-3)

    Using County General Funds from the CIP budget, DPW completed a stream restoration project behind the Ballenger Creek Elementary School during winter 2007. The project site is located on a section of Ballenger Creek that runs through County property adjacent to the school. The project continues to be maintained and monitored, and is functioning according to design. The goal of the project was to improve the condition of approximately 605 linear feet of stream to improve watershed water quality, instream and riparian habitat, and aesthetic conditions. Specific objectives throughout the project included:

  – Restore the stream channel and riparian area by utilizing natural stream channel design principles;

  – Create a stream channel and floodplain that is dynamically stable, provides hydrologic and sediment transport continuity, and if possible reestablish floodplain connectivity;

  – Create a range of aquatic habitats and associated riparian areas to enhance and support the existing ecological community;

  – Work within site constraints and other considerations, including development of a design consistent with local geology and avoid or minimize disturbance to existing trees, footbridge, sewer line, and other structures;

  – Improve the aesthetic value of the site; and

  – Identify and incorporate educational needs into the project to facilitate future learning opportunities associated with the stream and the restoration project.

7.5.3 Linganore Creek

7.5.3.1 Watershed Assessment in Linganore Creek Watershed

Frederick County completed an assessment of Lower Linganore Creek watershed in June 2002 (Perot et al. 2002b). Actions implemented to address recommendations from the final water quality plan included the following:

- Programmatic Opportunities

  – County staff developed an action plan to guide implementation of recommendations in the Source Water Protection Plan. Staff continued to work on implementation of the Lower Monocacy WRAS in the Linganore Creek Watershed.

- Continued coordination with NRCS/SCD to reduce livestock access to streams. This effort was addressed in Linganore as part of EPA 319 program and NFWF grants. Site visits were conducted with SCD/NRCS using a GIS "House Calls" tool.

- Conduct retrofit and restoration feasibility analysis to identify and prioritize BMP opportunities. A Retrofit/Restoration study was completed for the Lower and Upper Linganore Creek watersheds in July 2006.

- Monitor implementation of conservation plans within Agricultural Preservation Districts. The County's Agricultural Preservation Program has implemented an inspection program to verify that conservation plans are in place.

• Best Management Practices

- Facilitate local SWM control efforts in older developments near the lake. Lake Linganore Community Development Authority is in the construction phase of a road and drainage improvement project; work is finished in Coldstream, Balmoral and Meadows. Work will begin in the spring in Pinehurst and Nightengale. Frederick County's Division of Public Works is paying for the water and sanitary sewer upgrade portion of the project. The CDA is paying for road and stormwater improvements.Opportunities for County support of projects on private property were noted in the Retrofit/Restoration study. The County met with Linganore community groups such as Friends of the Lake to discuss restoration of public areas around the lake.

- Notify NRCS/SCD of livestock access to streams. Efforts to reduce livestock impacts to the stream were initiated as part of the WRAS. The NRCS/SCD is a MCWA partner and is addressing opportunities at SCA-identified livestock access sites as they arise. Frederick County also collaborated with Potomac Conservancy on house calls to farmers in the Linganore Watershed designed to enroll farmers in best management practices and reduce cattle access.

- Identify opportunities to improve water quality on County-owned properties (i.e., Linganore High School and County Public Safety Training Facility). As described below, these properties were evaluated in the July 2006 Retrofit/Restoration study. Redevelopment designs for the Public Safety Training Facility include bio-retention to provide on-site water quality treatment (CIP-46). Upcoming renovations at Linganore High School will include improvements to sewer and stormwater systems.

• Stream Corridor Restoration

- Investigate feasibility of restoring Bens Branch across from Millime Court. Site was evaluated and prioritized in the July 2006 Retrofit/Restoration study and completed in 2006.

- Investigate feasibility of restoring Bens Branch at Gas House Pike. Site was evaluated and prioritized in the July 2006 Retrofit/Restoration study and completed in 2006.

- Pinecliff Park site was chosen for stream restoration project based on severity and correctibility of problem at unnamed tributary. Greenhorne and O'Mara was selected as the design engineering firm (CIP-45). The project design was completed in 2009 and construction is scheduled for 2010.

- Further Investigations at Specific Sites

  - Contact MDE and EPA to determine if additional investigation of possible contamination issues associated with automobile scrapyard facility is warranted. Completed in 2002.

- Long-term Monitoring

  - Continued periodic monitoring of stream stations in Lower Linganore Creek. Monitoring is to take place again at regularly scheduled intervals.

7.5.3.2 Implementation of Restoration Efforts in Linganore Creek Watershed

The County has initiated a number of efforts to improve watershed conditions within Linganore Creek. These efforts, summarized below, build upon the existing work conducted by the County and other organizations, within the watershed.

- Stormwater Retrofit/Stream Restoration (R/R) Assessment

An R/R assessment was completed in July 2006 for the entire Linganore Creek watershed (Perot et al. 2006). This study identified and evaluated specific opportunities for improving stormwater management controls and stream restoration in the County's Upper and Lower Linganore Creek watershed management units. Elements of this study included a review of existing watershed information (including recent SCA stream walk data), map review to target efforts and solutions to the most promising areas, field investigations to refine proposed concepts for solutions, a February 2006 public workshop to solicit input from local stakeholders on problem areas and solution types, estimating pollutant loads and potential reductions using the Stormwater Management Model (SWMM), prioritization of opportunities, and development of a report containing recommendations and conceptual plans for the best watershed restoration opportunities.

The assessment identified 167 candidate project sites that could be used to improve watershed conditions (Table 7-6). The Tier 1 sites present the best opportunities for the County's CIP program (Table 7-7); estimates of pollutant load reductions and detailed fact sheets outlining conceptual plans for these sites were included in the report. The Tier 2 sites present good opportunities for the County, while the remaining sites are good opportunities for the County to work with Community Restoration partners.

Table 7-6. Summary of candidate restoration projects in Linganore Creek watershed				
	CIP Tier 1	**CIP Tier 2**	**Community Restoration**	**Total**
Agricultural Program			85	85
Low Impact Development	11	22	31	65
Stream Restoration	1		9	9
SWM Pond Results	3		5	8
Total	15	22	130	167

The County considers its consultant's recommendations as a preliminary prioritization and has continued to further refine these priorities, selecting from among these candidates based on additional factors and priorities that would influence successful implementation. To date, the County has selected a subset of high priority sites to pursue further. The County's selection process considered additional site-specific information, ownership, landowner cooperation, and additional project constraints to further refine the project approach and design and to determine whether additional action was warranted for each high priority candidate site.

Opportunities for watershed improvement are not solely limited to the 15 Tier I sites, because alternate avenues for implementation exist via the County's Community Restoration partners. Many of the Community Restoration and Tier II opportunities are ideally suited for implementation by these groups and organizations, which can often leverage additional public support, outside sources of funding, and other resources to put projects "in the ground." As described below, the County has already begun lending support to these projects and programs.

- CIP Projects

  – Pinecliff Park Stream Restoration (CIP-45)

    Investigation of the sites identified in the Restoration/Retrofit report led to the selection of the Pinecliff Park Stream Restoration Project. The tributary, within the Linganore planning area, is a direct tributary to the Monocacy. It was recently impacted by the construction of a water main but had impacts predating the structure that threatened culvert stability. The channel is a site of a significant amount of active erosion and will provide a highly visible project to benefit both the environment and the patrons of the public park. The project will restore about 1000 linear feet of stream by reconnecting it to its floodplain and reducing entrenchment, and will also involve riparian plantings and other stabilization techniques. The design engineering firm for the project is Greenhorne and O'Mara. The design was completed in 2009. The project will be funded with County General Funds and will be constructed in 2010. Pre-restoration monitoring is described in Section 7.5.3.3.

Table 7-7. Summary and ranking of candidate CIP watershed restoration opportunities in Linganore Creek. These sites (CIP Tier 1) represent the best opportunity for watershed improvements.

Project ID	Subwatershed	Project Type	Project Name	Location	Ownership	Project Description	Estimated Project Cost	Total Score (out of 100 points)
CIP Tier 1								
NL102	New London	LID	Linganore High School (TBD)	Old Annapolis Road	Public - County owned	Install linear rain gardens along Old Annapolis Road, in parking lots, and next to athletic fields; place rain gardens around parking lots; provide off-line bioretention at two outfalls; place detention micro-berms across drainage pathways; and plant wildflowers and trees in unused open space.	$1,352,000	75
TO105	Town Branch	LID	Liberty Elementary School (CCRP-1, Project #5)	Liberty Road	Public - County owned	Install linear and area rain gardens in traffic islands and landscape beds around school; build off-line bioretention garden below culvert outfall; place detention micro-berm along field margins; and provide linear rain gardens next to athletic fields.	$310,000	72
BA102	Bartonsville	Stream Restoration & LID	Pinecliff Park (CIP-3, Project #45)	Pinecliff Park Road	Public - County owned	Stabilize approximately 1,000 ft. of streambank; construct linear rain gardens along parking lot and road margins; place rain gardens in three parking lots; add detention micro-berm along stream and woods; buffer enhancement along Monocacy River; plant wildflowers on sledding hill (mow before sledding season); and plant wildflowers on top of sewer and water lines, and in unused open spaces.	$473,000	69
WB113	Woodville Branch	LID	New Estates Subdivision - LID 2	Cindy Court and North Annapolis Drive	Public - County ROW/Easement	Retrofit existing roadside swales with linear rain gardens throughout the subdivision.	$515,000	69
BA101	Bartonsville	SWM Pond Retrofit	Frederick County Public Safety Training Facility (CIP-4, Project #46)	Reichs Ford Road	Public - County owned	Upgrade control structure for Structure No. 123 (extended detention wet pond) to MD2000 standards and add sediment forebay to pond; place culvert retrofits at two roads; build detention berms and linear rain gardens near training areas; add infiltration trench to parking lot; plant wildflower and forested buffer around pond and along stream; and reforest unused open space on hillside.	$400,000	67
LB102	Long Branch	LID	Spring Ridge Elementary School	Ridgefield Drive	Public - County owned	Install rain gardens, infiltration trenches, and tree box filters in drive and parking areas; place a detention micro-berm along edge of playing fields; add linear rain gardens in roadside swales; build rain gardens in the northwest and southwest lawns; and plant unused open space with trees and wildflowers.	$792,000	66
WB111	Woodville Branch	LID	Willow Pond Estates - LID 2	Amys Terrace	Public - County ROW/Easement	Retrofit existing roadside swales with linear rain gardens throughout the subdivision.	$397,000	66

– Public Safety Training Facility Redevelopment (CIP-46)

Discussions with project owners on the top tier of potential CIP projects made WMS staff aware that the County Department of Program Development and Management in DPW was planning to redevelop the Public Safety Training Facility site and add water quality treatment through bioretention. This project is a good example of how to improve existing developed sites. The project is in the design phase, and water quality treatment is estimated at 15 acres.

- CCRP and MCWA Projects

Three grant-funded initiatives were utilized to implement CCRP and MCWA projects in the Linganore watershed: (1) Libertytown Stewards Project; (2) Holding Our Ground: Water Quality and Stewardship in Linganore Watershed; and (3) Linganore Creek TMDL – Urban Demonstration Project. A brief overview of each grant and its funding source along with a description of the projects implemented by project site location is provided below.

– Description of Funding Sources

❖ **Libertytown Stewards Project :** Frederick County secured $25,000 in grant funding from CBT for community restoration projects in Libertytown and completed all projects by December 2006. Town Branch, a tributary of Linganore Creek, runs through Libertytown. It was given the highest priority for targeted stream restoration action in the Lower Monocacy Watershed Restoration Action Strategy (WRAS).

❖ **Holding Our Ground - Water Quality and Stewardship in Linganore Watershed:** The National Fish and Wildlife Foundation (NFWF) provided $40,000 in funding to improve water quality in the Linganore Creek watershed by supporting educational initiatives targeted to increase stewardship ethics among watershed citizens through the development of the "House Calls" program. The "House Calls" program has allowed the Community Restoration Coordinator to make site visits to interested landowners to discuss specific property conditions and possible voluntary restoration, enhancement, and protection options. The GIS portion of the "House Calls" program consists of data layers such as watershed boundaries, agricultural preservation properties, stormwater management and storm drain systems, data from the Watershed Characterization and Stream Corridor Assessments (SCA), zoning, and soil.

The County's Community Restoration Coordinator met with the Town of Mt. Airy, the Holly Hills Homeowners Association, the Friends of the Lake, and the Lake Linganore Conservation Society. Presentations also included sharing 32 priority agricultural sites on 35 farms with four staff of the Soil Conservation District to enable them to target selected properties for further outreach. Twelve farms were selected for further outreach comprising more than 1200 acres with more than six miles of stream corridor. Of those farms identified, farm calls were made with landowners of a total of 730 acres. Eight urban sites were visited including one county park, one Mt. Airy municipal property and adjoining HOA property, four

schools, and two homeowners' association properties that collectively comprise 196 acres.

Quarterly E-newsletters to further promote watershed stewardship were published and are available on the MCWA website at http://www.watershed-alliance.com/ and are discussed in greater detail in Section 6.5.

- **Linganore Creek TMDL – Urban Demonstration Project:** The County secured grant funds from MDE in the amount of $216,237 for its Linganore Creek TMDL - Urban Demonstration Project under the EPA 319 (h) program. The Urban Demonstration Project is a comprehensive treatment of urban nonpoint source pollution. In this project, key landowners were targeted and offered increased technical assistance in the design and installation of BMPs for sediment and phosphorus control. The project supported enhancing riparian-forest buffers and using on-site approaches to reduce nonpoint source pollution.

  Efforts began in December 2006. Project sites included schools, regional parks, golf courses, and other publicly owned property. Interpretive signs were posted to help citizens learn about the restoration projects and the benefits associated with improved stormwater management. All projects were completed by December 2008.

– Description of Projects

- Liberty Elementary School (CCRP-5)

  The Liberty Elementary School principal, staff, and Parent Teacher Student Association (PTSA) approved the installation of a rain garden designed to treat stormwater runoff from the parking lot and school that has approximately 72-percent impervious cover. Two local Master Gardener volunteers and Cub Scout Pack 1062 participated in the planting and have committed to assist with maintenance. Potomac Conservancy designed the rain garden; installation was completed in spring 2006. Volunteers planted 100 native perennials and 10 native trees and shrubs on April 12, April 13, and May 6, 2006. The rain garden treats approximately 0.25 acres.

- Liberty Village Cohousing Community (CCRP-6)

  Liberty Village Cohousing Community is a residential community that adjoins Libertytown Park;. The homeowners' association has worked to treat approximately 17.83 acres through the installation of three rain gardens treating roughly 0.43 acres, the installation of an urban forest buffer treating roughly 8.4 acres, and the installation of an urban grass buffer treating roughly 9 acres. Project installation occurred from 2006 to 2008. Members of Liberty Village were required to sign maintenance agreements as a stipulation for project funding.

- St. Peter the Apostle Roman Catholic Church (CCRP-7)

  The DNR Forest Service designed a Forest Stewardship Plan for the church's property through which Town Branch flows. Volunteers from the church and a local Eagle Scout group planted 100 native sedges, 54 native shrubs, and 30 native trees in fall 2006, treating a total area of approximately 1.52 acres.

- Libertytown Community Park (CCRP-55)

  A number of restoration initiatives were implemented on the Libertytown Community Park property between 2006 and 2008 resulting in an approximate total area of treatment equaling 29.88 acres. Projects installed included urban forest buffers, urban grass buffers, and rain gardens. The park contains a wetland and a tributary to Town Branch making it a high priority for restoration.

- Mt. Airy Village Gate Park (CCRP-71)

  Approximately 8.13 acres of treatment have been provided on the Mt. Airy Village Gate Park property. In 2007, 2.2 acres were planted with Tree-Mendous container stock treating a 6.6-acre area. A 0.28-acre riparian forest was planted with container stock as well, treating a 0.84-acre area. Another riparian zone with 595 native plants was planted during 2008 treating approximately 0.69 acres.

- Mt. Airy East West Park (CCRP-72)

  In March 2007, 0.8 acres were planted with Tree-Mendous container stock treating a 2.4-acre area. Three acres of seedlings were planted to create an upland forest treating nine acres. Extensive weed control was performed during summer 2007 and 2008.

- Deer Crossing Elementary School (CCRP-80)

  Parents, teachers and students installed a 600-square foot rain garden equivalent to 0.4 acres of treatment for their property. A rain barrel redirects the roof runoff into the garden. It took 66 hours of volunteer time to complete the project during May 2007.

- Holly Hills HOA (CCRP-142)

  A riparian forest buffer was installed to treat approximately nine acres during 2007. Investment in weed control for 2007 by the HOA and the 319 grant is estimated at $4,500.

- Holly Hills Country Club (CCRP-143)

  A 3.5-acre riparian corridor was planted in October 2007 and treats 10.5 acres.

- Pinecliff Park (CCRP-144)

  This large, established park sits directly adjacent to the Monocacy. Staff planted 40 large-diameter native trees on October 10, 2007. The riparian buffer treats about 0.14 acres in the Lower Linganore Creek Watershed.

- Mt. Airy Windy Ridge Park (CCRP-146)

  The Forest Stewardship Plan for this 88-acre park included the establishment of a 5.9-acre urban grass buffer treating approximately 17.73 acres and twelve acres of native trees and shrubs treating approximately 36 acres. Weed control to treat competing invasive vegetation was completed in 2008.

- Fred Archibald Sanctuary (MCWA-14)

  The planting is located on one of the two sanctuary properties of the Audubon Society of Central Maryland. The four-acre planting is adjacent to a tributary to Hazelnut Run (a tributary to Linganore Creek) and treats 12 acres. This project consists of a mix of 2.5 acres of large growing deciduous trees, 0.75 acres of shrubby species, and 0.75 acres of conifers. A permanent conservation easement for the sanctuary was donated to Maryland Environmental Trust in 2007.

7.5.3.3 Pinecliff Park Restoration Monitoring

Introduction

Pinecliff Park, located at 8350 Pinecliff Park Road, Frederick County, MD, contains a small stream that is a tributary to the Monocacy River. Presently, the stream is exhibiting severe bank and in-channel erosion, contributing substantial sediment to downstream waterbodies. Excess sediment in streams and rivers can cause filling in of pools, altered instream vegetation and flow, reduced photosynthesis, altered macroinvertebrate and fish communities, and disruption of the food web. Restoration of 1100 linear feet of the stream in Pinecliff Park is planned, with a goal of reducing the loads of sediment that impair the Lower Monocacy Watershed's Use IP designation for aquatic health. Frederick County intends to assess long-term progress toward the goal of reducing sediment input through geomorphological monitoring of the stream during pre-and post- restoration periods. This monitoring will address the goals of the sediment TMDL developed for the Lower Monocacy.

Versar reviewed past data collected for the original HEC-RAS model prepared for the stream restoration design of the stream in Pinecliff Park prepared by the County's restoration consultants, Greenhorne and O'Mara (G&O) in partnership with Clear Creek Consultants. In early September 2009, Versar staff met with Frederick County DPW staff at Pinecliff Park to select six cross sections for pre-construction monitoring. Cross sections were spread out along the entire 1,100 linear feet of stream to enable a thorough assessment of the restoration effects.

In early October 2009, Versar staff performed pre-construction geomorphic monitoring at the six pre-selected sites chosen in September. At each site, a permanently monumented cross-section

was established, and labeled with end pins marked "Versar Stream Survey" along with the respective cross-section name (Cross Section A through F; Figure 7-5). GPS coordinates were recorded at each cross section end pin to enable field crews to locate the pins during future visits to the site. Cross Section A was the furthest upstream cross section, located at G&O's XS-3. Moving downstream, Cross Section B was located at G&O's XS-7, and Cross Section C was located between G&O's XS-9 and XS-10, just downstream (west) of an existing basketball court. Cross Section D was located at G&O's XS-15, Cross-Section E was located between G&O's XS-17 and XS-18, and the furthest downstream Cross Section (F) was located between G&O's XS-21 and XS-22, just upstream of the gabion baskets present along the right hand side of the channel.

At each cross section, Versar staff conducted a cross-sectional survey to characterize the shape of the stream channel (Figure 7-6, Figure 7-10, Figure 7-14, Figure 7-18, Figure 7-22, Figure 7-26). Features including top of bank, bankfull height, and edge of water were noted and elevations were measured. Fixed points chosen to serve as benchmarks were surveyed at each cross section to tie in existing channel elevations with elevations of fixed features. Representative Wolman pebble counts were conducted at each location, weighted based on the proportion of riffle and pool areas in the vicinity of the cross section (Figure 7-7, Figure 7-11, Figure 7-15, Figure 7-19, Figure 7-23, Figure 7-27). Full photo-documentation was conducted from fixed photo-points recorded with a differential GPS to document the baseline conditions, and will be used after construction is completed to document the stability of channel features, establishment of streamside vegetation, and other physical features (Figures 7-8 and 7-9, Figures 7-12 and 7-13, Figures 7-16 and 7-17, Figures 7-20 and 7-21, Figures 7-24 and 7-25, Figures 7-28 and 7-29). In addition, the slope of the entire reach was measured.

Substrate Characterization

As described previously, representative Wolman pebble counts were conducted at each cross section, weighted by the proportion of riffles and pools in the vicinity of the cross section. We provide a summary of the pebble count data in Table 7-8.

Table 7-8. D50 and D84 values for weighted pebble counts conducted at 6 cross sections of the stream in Pinecliff Park in early October, 2009.

Cross-Section	D50 (mm)	D84 (mm)
A	0.06	28.24
B	0.06	38.93
C	0.04	0.10
D	11.73	45.0
E	0.92	18.64
F	10.75	218.0

Figure 7-5. Aerial photograph of Pinecliff Park with locations of 6 stream cross-sections surveyed by Versar in October 2009.

Cross Section A:

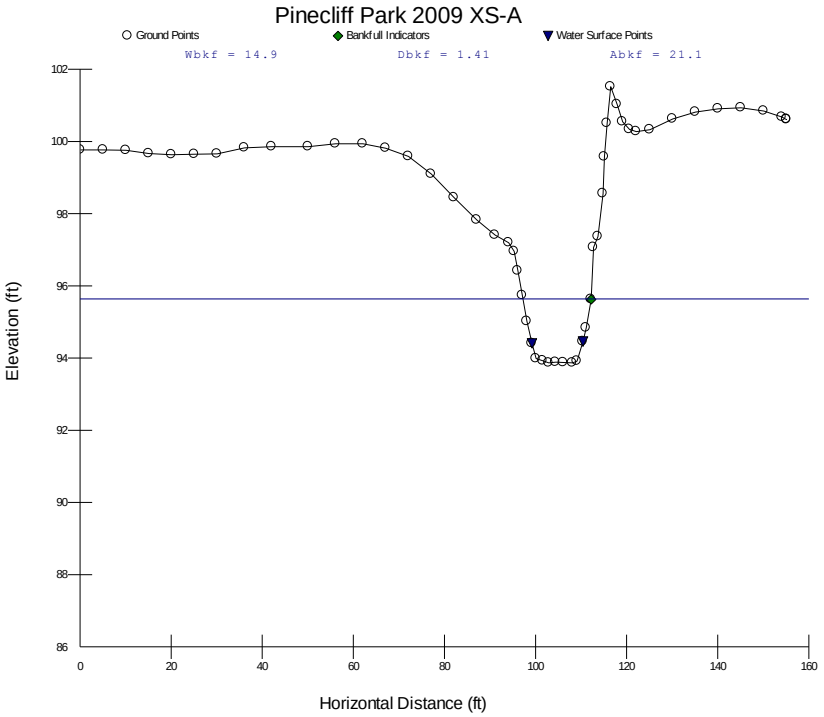

Figure 7-6. Cross-sectional graph depicting shape of channel at Cross Section A, as surveyed by Versar staff on October 9, 2009.

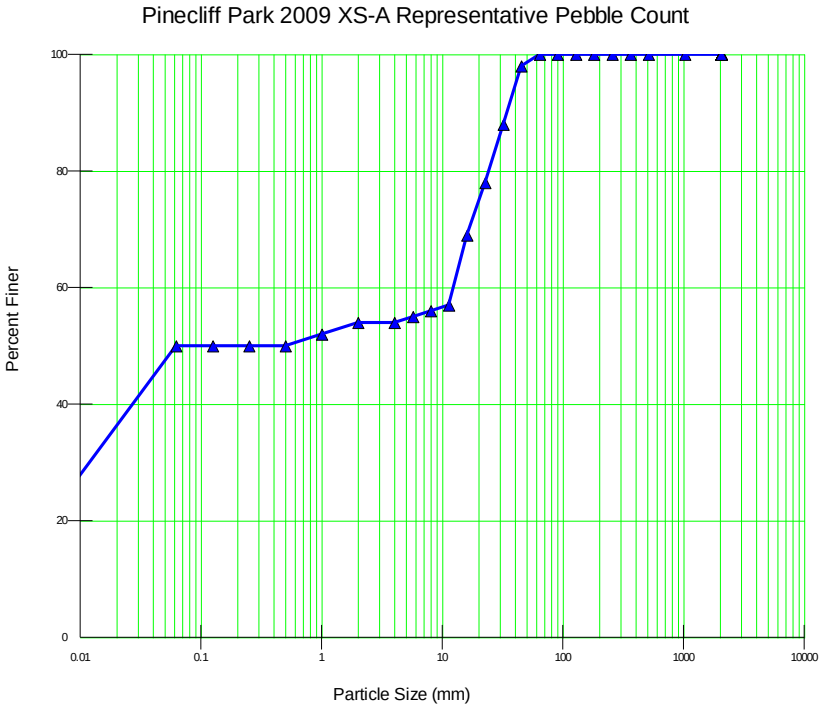

Figure 7-7. Particle distribution at Cross Section A as surveyed on October 9, 2009. Weighted 10% riffles, 90% pools.

Figure 7-8. This photo was taken in the middle of the streambed at Cross Section A looking downstream (39.39057941260, -77.37541977810) on October 9, 2009.

Figure 7-9. This photograph was taken as Versar field staff surveyed Cross Section A on October 9, 2009. This photograph was taken from the left bank, looking across to the right bank (39.39056093020, -77.37539680070).

Cross Section B:

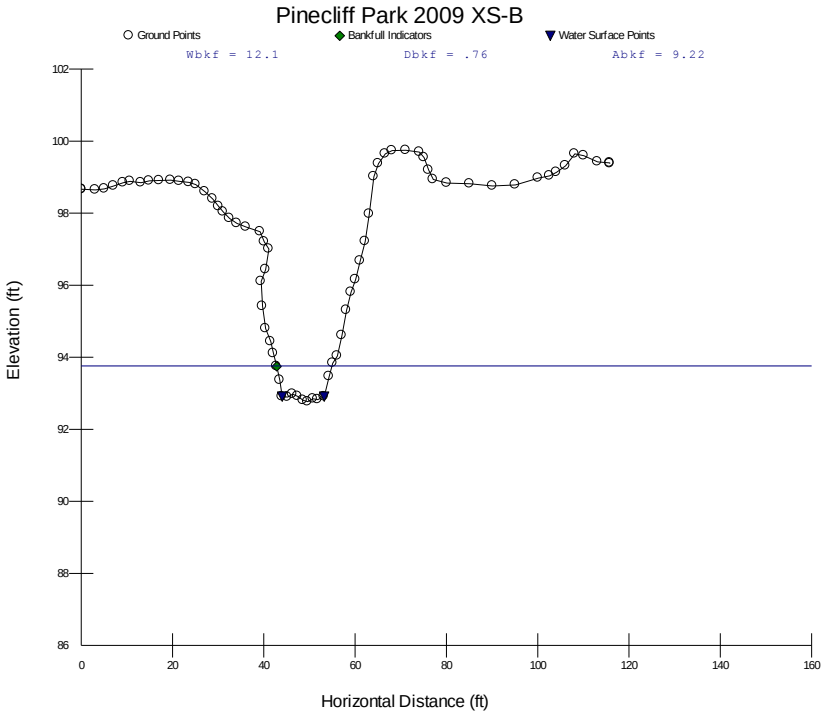

Figure 7-10. Cross-sectional graph depicting shape of channel at Cross Section B, as surveyed on October 9, 2009.

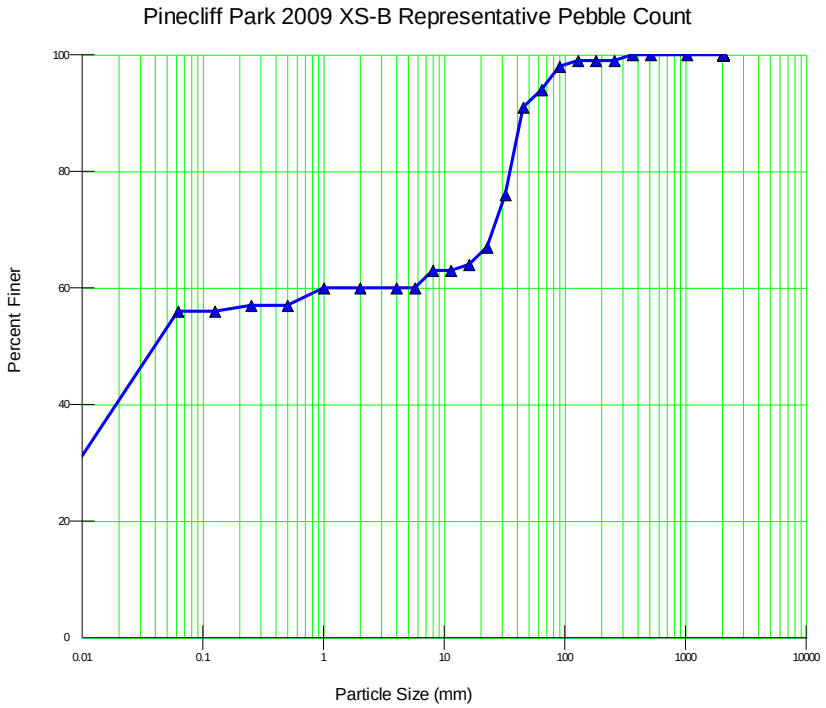

Figure 7-11. Particle distribution at Cross Section B as on October 9, 2009. Weighted 40% riffles, 60% pools.

Figure 7-12. This photograph was taken from the middle of the streambed looking downstream at Cross Section B, October 9, 2009 (39.39006190000, -77.37575930330). A storm drain enters the stream along the left bank.

Figure 7-13. This photograph depicts the highly erosive streambank present along the right side at Cross Section B as observed on October 9, 2009 (39.39020485580, 77.37568820080).

Cross Section C:

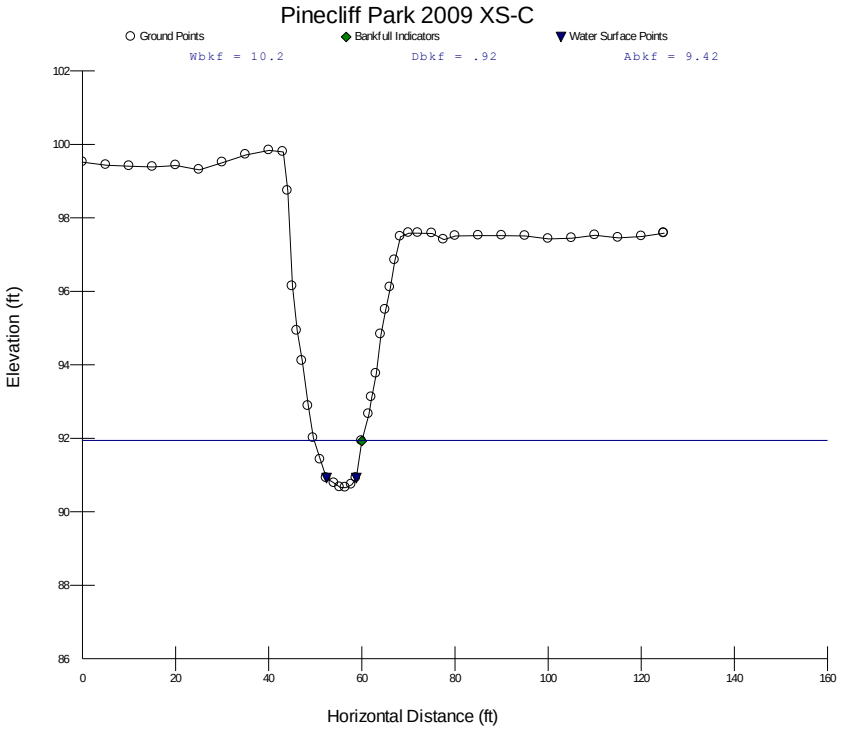

Figure 7-14. Cross-sectional graph depicting shape of channel at Cross Section C, as surveyed on October 9, 2009.

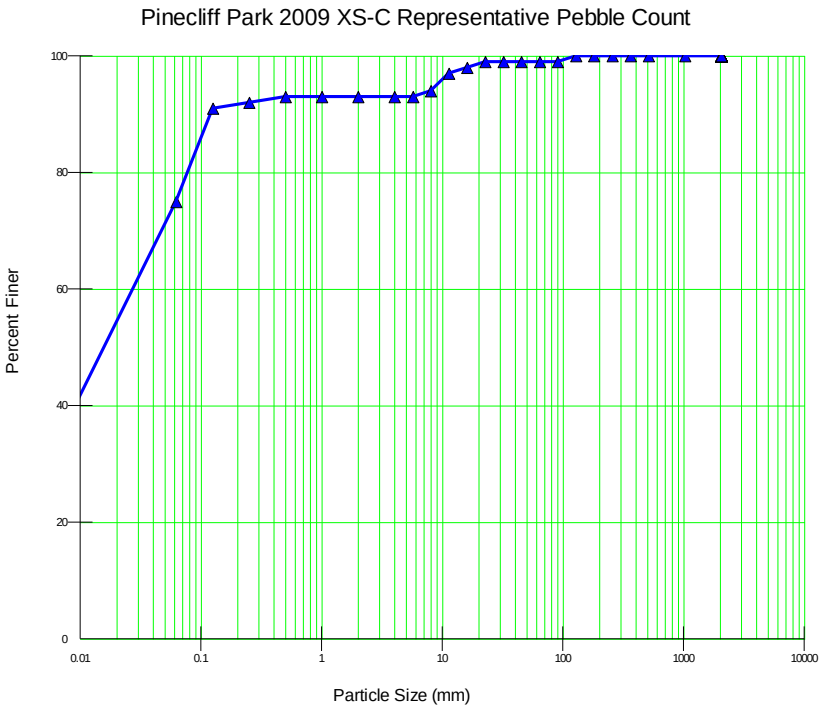

Figure 7-15. Particle distribution at Cross Section C as surveyed on October 9, 2009. Weighted 20% riffles, 80% pools.

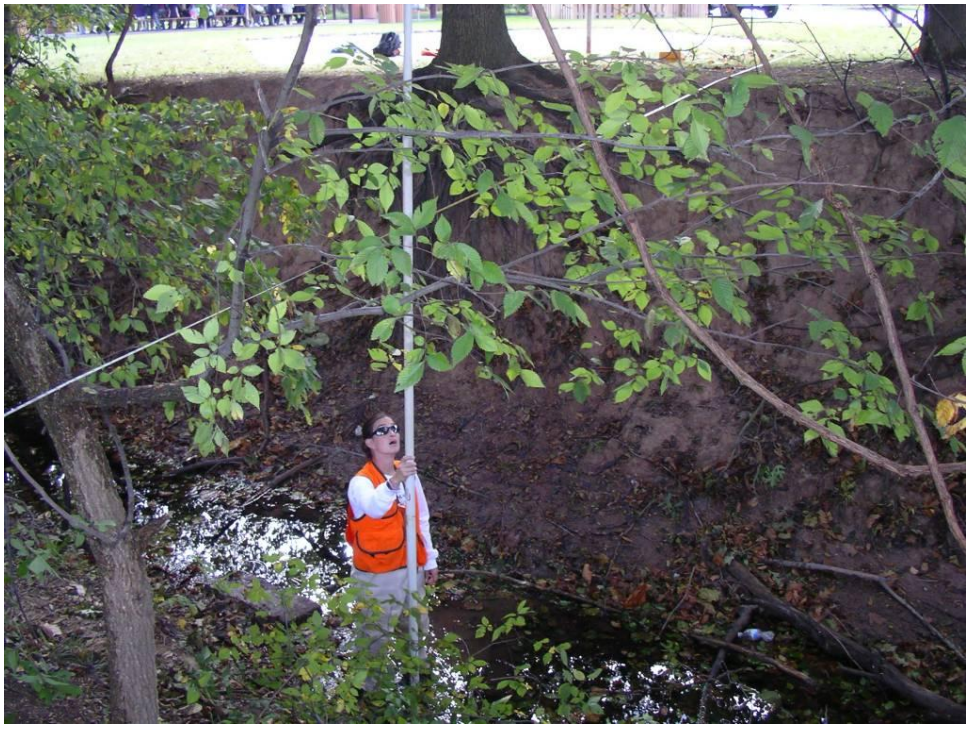

Figure 7-16. This photograph taken from the right bank depicts Versar field staff surveying Cross Section C on October 9, 2009 (39.38984189790, -77.37619122560). At this cross section, the stream is deeply incised and banks are raw and highly erosive.

Figure 7-17. This photograph depicts the highly erosive left bank, looking downstream at Cross Section C. Streambank erosion has jeopardized the integrity of this tree. (39.38976893410 -77.37615316310)

Cross Section D:

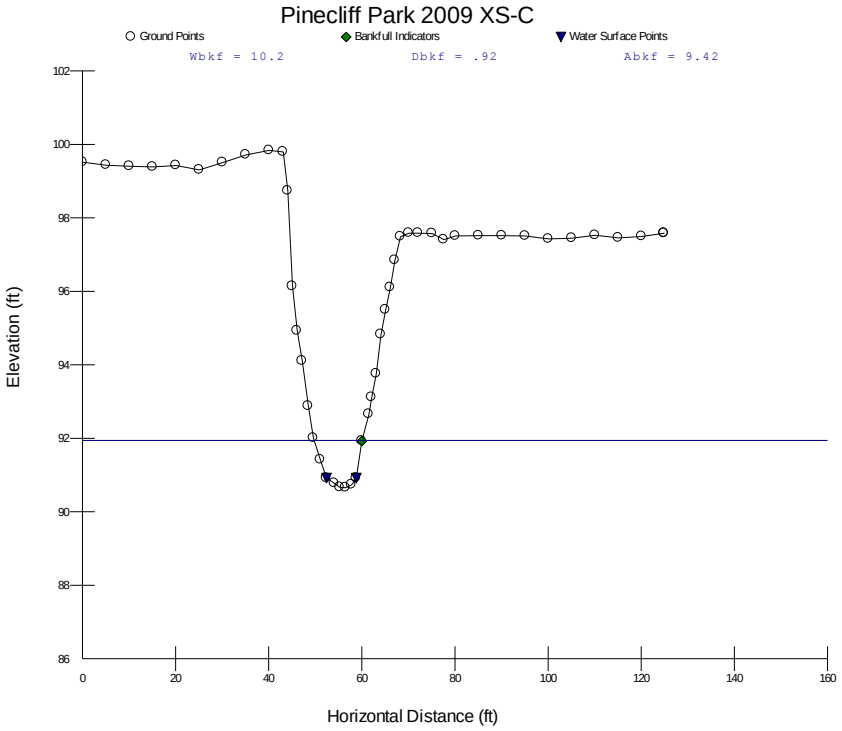

Figure 7-18. Cross-sectional graph depicting shape of channel at Cross Section D, as surveyed on October 6, 2009.

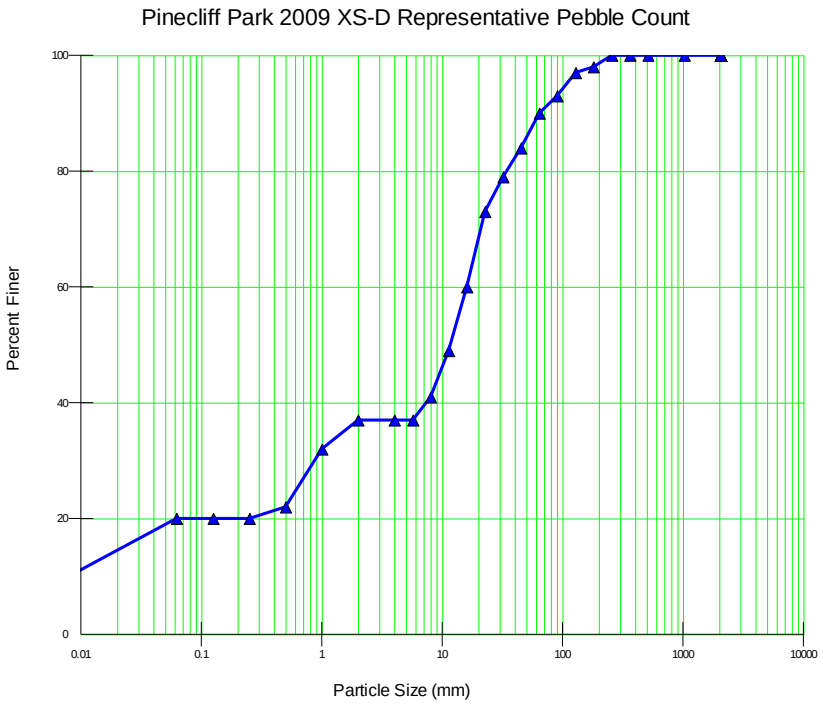

Figure 7-19. Particle distribution at Cross Section D as surveyed on October 9, 2009. Weighted 30% riffles, 70% pools.

Figure 7-20. This photograph was taken by Versar field crews on October 6, 2009 from the left bank at Cross Section D looking downstream (GPS coordinates not available).

Figure 7-21. This photograph depicts Cross Section D as surveyed on October 6, 2009 (GPS coordinates not available).

Cross Section E:

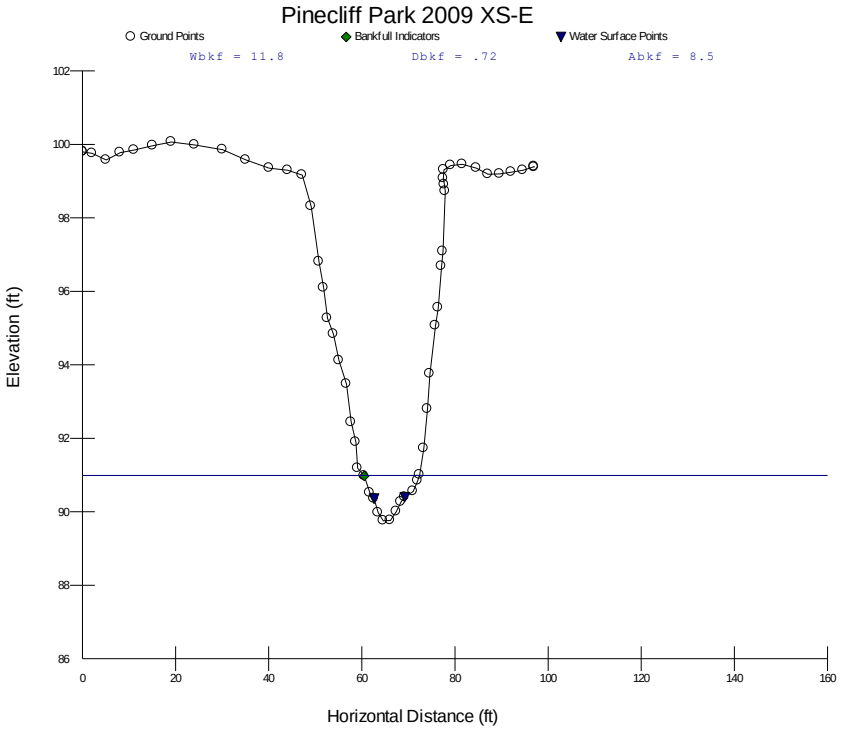

Figure 7-22. Cross-sectional graph depicting shape of channel at Cross Section E, as surveyed on October 6, 2009.

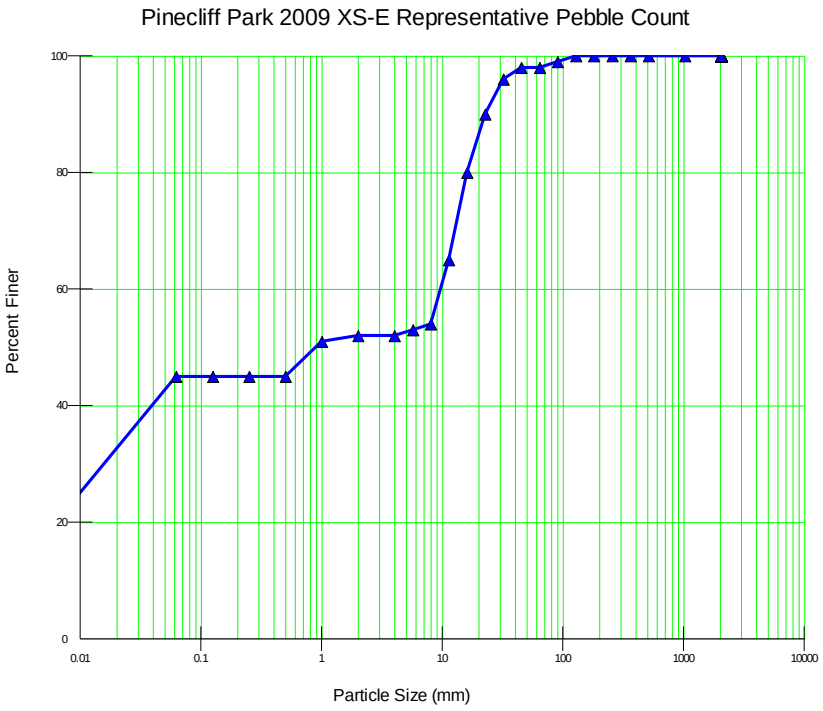

Figure 7-23. Particle distribution at Cross Section E as on October 6, 2009. Weighted 60% riffles, 40% pools.

Figure 7-24. This photograph was taken from the concrete road bridge crossing the stream in Pinecliff Park, looking upstream at Cross Section E as surveyed on October 6, 2009 (GPS coordinates not available).

Figure 7-25. This photograph depicts Versar field staff surveying Cross Section E on October 6, 2009. This cross section is just upstream of the road crossing and banks are highly erosive. (39.38950711320, -77.37760461360).

Cross Section F:

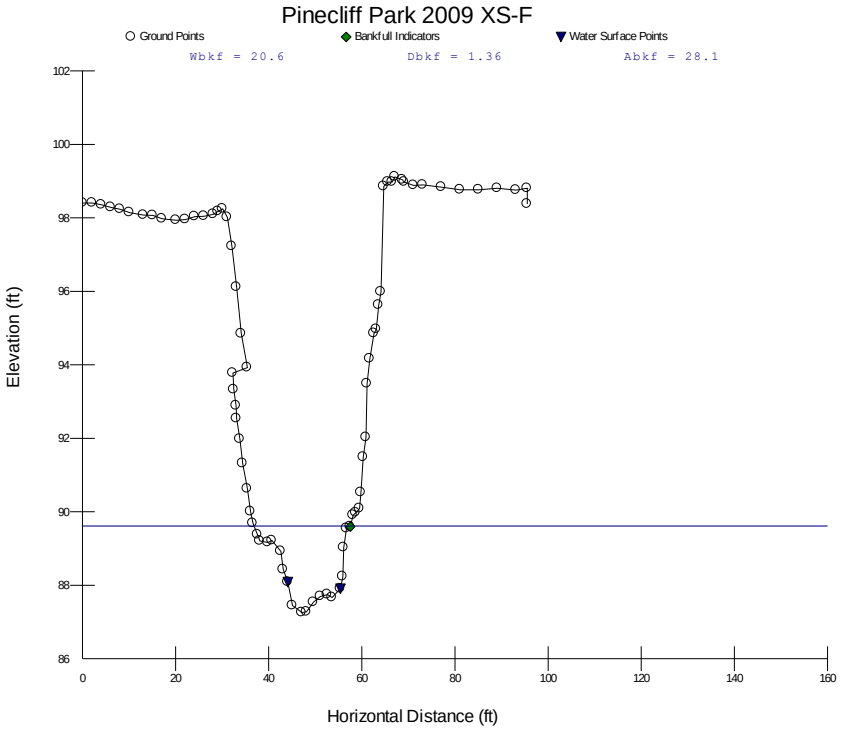

Figure 7-26. Cross-sectional graph depicting shape of channel at Cross Section F, as surveyed on October 6, 2009.

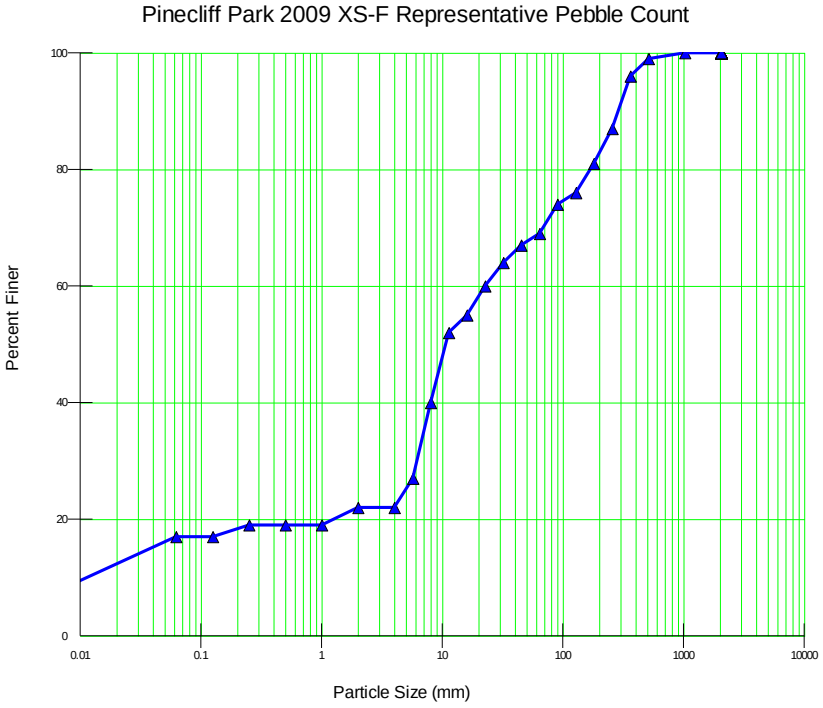

Figure 7-27. Particle distribution at Cross Section F as surveyed on October 6, 2009. Weighted 80% riffles, 20% pools.

Figure 7-28. This photograph was taken on October 6, 2009 from the left bank of the stream in Pinecliff Park looking upstream to Cross Section F, which is just below the bridge crossing. (39.38941206350, -77.37809646870)

Figure 7-29. This photograph was taken on October 6, 2009 from the road bridge across the stream in Pinecliff Park looking downstream at Cross Section F and toward the confluence with the Monocacy River. (39.38948451100, -77.37791345710). Note the gabion baskets lining the right bank just downstream of the cross section.

Slope

An overall estimate of channel slope was calculated based on a survey along the entire study reach. At the upstream end, an initial reading was taken at the top of a pool just above Cross Section A. At the downstream end, a final reading was taken at the top of a pool just below Cross Section F. Over this 1,096 linear foot length of stream, slope was 0.7%.

7.5.4 Bennett Creek

The County will propose including the Bennett Creek watershed as its next priority for restoration and protection in its next NPDES MS4 permit. In good faith, the County has moved forward with activities in this watershed. The County contracted with Tetra Tech to complete a Watershed Assessment and Restoration/Retrofit Assessment for the Bennett Creek watershed.

7.5.4.1 Watershed Assessment in Bennett Creek Watershed

The Bennett Creek Watershed was included as part of the Lower Monocacy Watershed Restoration Action Strategy (WRAS) in 2004. Parts of Bennett Creek were walked using the Stream Corridor Assessment Protocol. In the WRAS, there are 23 sites listed as priority for restoration in the Bennett Creek Watershed. In Bear, Fahrney, North, Pleasant, and Urbana Branches there are combinations of fish migration barriers, inadequate riparian buffer, livestock access to the stream (horses, cattle), exposure to future development, and several areas of accelerated erosion due to golf courses and residential developments.

In addition to the Lower Monocacy WRAS, a Watershed Assessment was completed by Tetra Tech in March 2008. The assessment involved gathering all available information on the condition of the watershed; prioritizing the fifteen subwatersheds within Bennett Creek for restoration; and identifying priority restoration sites and recommending projects to restore conditions.

Three subwatersheds received the highest priority based on the results of the above process: Fahrney, Bennett Upper, and Bennett Middle. These were located in areas that tend to have higher development and percent urban land use.

- Stormwater Retrofit/Stream Restoration (R/R) Assessment

An Assessment of Stormwater Management Retrofit and Stream Restoration Opportunities in Bennett Creek was completed in April 2009 by Tetra Tech. The goal of the retrofit assessment was to provide the County and community stakeholders with information on the condition of the watershed, to identify the most likely stressor sources in the watershed, and to recommend projects to reverse, prevent, or slow stream and watershed degradation.

Eleven candidate restoration projects were identified. Six of the sites are located in the Fahrney subwatershed and the others are located in the Urbana, Pleasant, Little Bennett, Bennett Upper, and Bennett Middle. Projects were divided into three types: CIP Tier 1, CIP Tier 2, and Community Restoration Projects (CRP). Four projects were recommended at CIP Tier 1 and two

projects were recommended at CIP Tier 2. The remaining five projects were recommended as CRP projects (Table 7-9).

7.5.4.2 Implementation of Restoration Efforts in Bennett Creek Watershed

- CIP Projects

  – Urbana Highway Operations Satellite Yard (CIP-190)

    The existing stormwater management facility will be upgraded to meet current stormwater manual requirements. The upgrade will include infiltration/bioretention elements and will result in a treatment of approximately 5.77 acres.

  – Englandtowne SWM Retrofit Project (CIP-207)

    The Englandtowne SWM pond has been selected as a CIP project for the Bennett Creek watershed. The stormwater management structure was constructed in 1993. Proposed actions from the Bennett Creek R/R report include converting the dry pond to add water quality treatment and completing a stream restoration upstream of the pond to reduce sediment loads. The County has contracted with RK&K to develop designs for the project. It is anticipated that designs will be completed in 2010 with construction to follow. This project has not been included in Table 7-5 because it is still in the early stages of planning.

  – Green Valley Fire Station (CIP-208)

    The existing stormwater management will be retrofitted to provide water quality treatment for additional development that will occur on the 2.41 acre site. Scheduled retrofits include installation of new grass swales. The project is currently in the feasibility study phase so has not been included in Table 7-5.

- CCRP and MCWA Projects

Four grant-funded initiatives are being utilized to implement CCRP and MCWA projects in the Bennett Creek watershed: (1) Bennett Creek Targeted Restoration Initiative Phase I; (2) Bennett Creek Targeted Restoration Initiative Phase II; (3) Urban Wetlands Program, Bennett Creek Watershed Pilot; and (4) Bennett Creek Watershed Urban BMP Demonstration Project. A brief overview of each grant and its funding source along with a description of the projects implemented by project site location is provided below.

  – Description of Funding Sources

    ❖ **Bennett Creek Targeted Restoration Initiative Phase I and II:** The Potomac Conservancy, a MCWA partner, received grant funds from CBT to implement Phases I and II of the Bennett Creek Targeted Restoration Initiative to improve water quality in the Bennett Creek watershed. Urban and suburban residential, commercial/

Table 7-9. Total Scores, estimated costs and additional information on the candidate sites. Candidates within each project type are listed in order of highest priority to lowest (the higher the total score, the higher the priority).

Project Type	Project ID	Subshed	Project Name	Ownership	Location	Project Description	Estimated Cost	Total Score
CIP Tier 1	F7	Fahrney	Englandtowne SWM Pond	Public – County Commissioners	West side of Chaucer Ct. before cul-de-sac	Gravel wetland or wet pond, stream restoration	$316,060 or $248,560	80.0
CIP Tier 1	F4	Fahrney	Kemptown Park – Stream Restoration	Public – County Commissioners	Church Rd	Channel restoration	$283,200	78.3
CIP Tier 1	F3	Fahrney	Kemptown ES	Public – Board of Education	3456 Kemptown Church Rd	Bioretention areas, bioswales, landscape infiltration, pipe outfall retrofit	$424,530	76.7
CIP Tier 1	F5	Fahrney	Kemptown Park - LID	Public – County Commissioners	Church Rd	Bioretention areas, bioswales, rain gardens	$109,598	75.0
CIP Tier 2*	U1	Urbana	Urbana Park	Public – County Commissioners	3636 Urbana Pike	Bioretention areas, bioswales, landscape infiltration, erosion control	$144,130	61.7
CIP Tier 2*	F1	Fahrney	Green Valley ES	Public – Board of Education	11501 Fingerboard Rd	Bioretention area, green roof, retrofit existing structure into an infiltration trench, add'l curb cuts	$197,500	58.3
CRP	BU2	Bennett Upper	Persimmon Residential	Private	Persimmon Drive	Bioretention areas, bioswales, culvert/bridge improvements, stream and channel restoration	$1,062,550	78.3
CRP	P3	Pleasant	Pleasant Grove/Keating Residential	Private	Keating Court	Convert ditches into bioswales	$81,250	73.3
CRP	F12	Fahrney	Maryland Manor Residential	Private	Maryland Manor	Bioswales, erosion control	$257,500	66.7
CRP	BM3	Bennett Middle	Long Fence	Private – Commercial	2520 Urbana Pike	Gravel wetland	$62,000	58.8
CRP	LB1	Little Bennett	Little Bennett Industrial	Private – Industrial	Hyatt Park off Tyler Road	Bioretention, retrofit dry pond to gravel wetland, bioswale repairs	$222,500	52.1

*These sites may also make good candidates for CRP project

industrial, institutional, and agricultural properties are being targeted along Pleasant, Fahrney, Urbana, North, and Bear Branches.

- ❖ **Urban Wetlands Program, Bennett Creek Watershed Pilot:** In January 2007, Frederick County Government's Watershed Management Section (WMS) was awarded a $247,800 grant from the Environmental Protection Agency (EPA) and the Maryland Department of Environment (MDE) for the Urban Wetlands Program (UWP), Bennett Creek Watershed Pilot project. The UWP project provides the foundation for identifying the characteristics of high quality reference wetlands in Frederick County. Such wetland characteristics and data can be used to influence important water resource management and land use decisions and can provide guidance on prioritizing the protection, creation, restoration, and enhancement of wetlands in urban areas. The long-term goal of the project is to develop a wetland strategy that maintains data on current wetland conditions and outlines methods for constructing new wetlands that provide the same level of critical habitat for amphibians, vegetation, and birds, as do well-established wetlands. The project also includes education and outreach to Frederick County Public School teachers and students about wetland functions, and the establishment of four wetland restoration/enhancement projects.

- ❖ **Bennett Creek Watershed Urban BMP Demonstration Project:** The County's WMS was awarded a $234,545 grant from EPA and MDE for the Bennett Creek Watershed Urban BMP Demonstration Project in July 2008. The funds were awarded to implement riparian buffer and nonstructural urban BMPs at select sites and to conduct Years 3 and 4 of the Urban Wetlands Program habitat assessment monitoring described above.

– Description of Projects

- ❖ Urbana High School SWM Wetland Project (CIP-4)

  WMS, along with teachers and students from the Schoolyard Habitat Program, installed a wetland project during fall 2009. The wetland project treats approximately 18.3 acres of parking lot.

- ❖ Windsor Knolls Middle School (CCRP-11)

  Windsor Knolls Middle School participated in two tree planting events to help establish approximately 7 acres of riparian buffer treating approximately 21 acres. A rain garden has also been installed treating approximately 0.25 acres. During 2009 a stormwater wetland was installed treating approximately 13.6 acres. During spring 2010, an additional 5 acres of trees will be installed treating 15 acres.

- Kemptown Elementary School (CCRP-13)

  In 2006, students and teachers installed a 500-square foot rain garden to catch runoff from one of their parking lots. The area treats approximately 0.25 acres. In 2008, two tree planting areas were established to help increase the tree canopy on the school's campus. Combined, these areas treat approximately 1.35 acres.

- Urbana Middle School Tree Planting (CCRP-159)

  Approximately 0.25 acres of trees were planted through the Schoolyard Habitat Program. Additional feature trees were installed during fall 2009 to help the Frederick County Public Schools meet their adopted tree canopy goal.

- Kemptown Park (MCWA-191)

  Using funding from a Chesapeake Bay Trust grant, the Potomac Conservancy installed a bioretention facility to treat stormwater leaving the parking lot in Kemptown Park. The project was designed by the Center for Watershed Protection (CWP) and was completed in 2009. The project treats 0.42 acres.

- Urbana Community Park Tree Planting (CCRP-195)

  In April 2009, approximately 2.2 acres of riparian buffer were installed in an area of the park that had previously been cropped.

- Bar-T Mountainside Challenge and Retreat Center Projects (CCRP-198)

  A number of projects have been installed and are planned for Bar-T Mountainside Challenge and Retreat Center. During spring 2009 approximately 9.6 acres of riparian buffers were installed to treat 28.8 acres. This riparian buffer provides a 100-foot buffer to an unnamed tributary of North Branch, a tributary to Bennett Creek. During fall 2009, three rain gardens were installed in existing grassed swales. An additional five are planned for installation during spring 2010. All eight rain gardens will treat approximately 0.25 acres of parking lot. A wetland project is planned for construction during summer 2010. It will treat approximately 5 acres and will increase habitat for amphibians.

- Worthington Manor Golf Course Wetland and Buffer Project (CCRP-199)

  A tributary to North Branch, a tributary to Bennett Creek, runs through a portion of the golf course. The tributary is largely unbuffered and has two wetland areas. WMS is partnering with the Potomac Conservancy to install a riparian buffer and wetland enhancement project. Invasive species control has occurred to treat Ailanthus and reed canary grass. Construction of the wetland enhancement project is scheduled for summer 2010 and the riparian buffer will be installed during fall 2010. The project will treat an estimated 33 acres.

❖ Urbana Elementary School Bioretention Swale (CCRP-210)

A bioretention/bioswale will be installed to mimic a dry creek bed. WMS is partnering with the Potomac Conservancy to design and install the project. The Center for Watershed Protection completed the designs for the facility. It will treat drainage from approximately six acres of parking lot, roof top, and street.

7.5.5 Impervious Area Reduction Efforts Countywide and in Other Watersheds

The watershed restoration projects described above meet both watershed-specific restoration goals identified in the watershed assessments and the County's overall goal of reducing untreated urban impervious surfaces. Watershed restoration for the projects described below is not required in the second-generation permit as it relates to Watershed Assessment and Restoration, but the projects count towards the reduction of untreated impervious area.

Frederick County continues to work towards its watershed restoration goals through its community restoration projects and by working with the Monocacy & Catoctin Watershed Alliance and other local partnerships. The following section outlines progress made in implementing restoration projects through these partnerships.

- Countywide Efforts

  – Backyard Buffers (CCRP-8)

  The Potomac Watershed Partnership (PWP) continued to sponsor the Backyard Buffer program for the eighth year and assisted 114 households in 2009. A total of 125 bundles were distributed. The County assisted in program implementation by publicizing, assisting with distribution, and identifying landowner names and addresses in priority watersheds to target with mailings. The Backyard Buffer packets distributed to participants include 25 tree/shrub seedlings of five different species. If seedlings are planted as instructed, with 6' x 6' spacing, one packet will cover 2,500 square-feet of land. Participants have the option to receive more than one packet of seedlings if desired. To date, approximately 48.6 acres have been treated, projecting a 50% mortality (this is based on survival rates of unmonitored tree planting projects; monitored projects typically have a 20% mortality).

  – Septic Upgrades (CCRP-18)

  The Frederick County Health Department, in partnership with Canaan Valley Institute (CVI, a Monocacy & Catoctin Watershed Alliance partner), was awarded over $700,000 through the Maryland Bay Restoration Fund (BRF) in order to address nutrient impacts by failing and under-performing On-site Disposal Systems (OSDS) in the Monocacy Watershed and in Frederick County's proposed source water protection areas.

  Throughout Frederick County, 35 OSDS were upgraded to reduce the concentration of nitrogen in the OSDS effluent by 50% or more. CVI worked with the Health Department

to identify and prioritize potential sites, coordinate with homeowners, select appropriate technologies, oversee installation, and establish a management framework.

The upgraded systems included a commercial-sized system at Eunice's Restaurant on Biggs Ford Road. All of the systems have replaced failing or out of date, non-compliant systems such as cesspools.

– Street Sweeping – Roads and Bridges (CCRP-192)

Recently, Frederick County Government approved the purchase of a vacuum-assisted street sweeper. The purchase of the new street sweeper allows for year-round sweeping rather than the twice per year sweeping that occurred in previous years. In 2009, Frederick County Highway Operations swept 430.31 acres of roads and bridges. The type of sweeper purchased was recommended in the Road Maintenance Report that was conducted by the NPDES compliance program and was purchased to meet NPDES goals. The sweeper is used heavily in the winter months to remove excess deicing material from roads and bridges.

MDE's review of the 2008 Annual Report included questions about street sweeping. Frederick County sweeps in rural areas to remove road salt, which differs from programs that sweep in dense, urban areas for general road pollutants. We have provided information on the volume of material collected but have a difficult time comparing the volume to other programs due to the heavy emphasis on salt. Additionally, only the area of road surface swept is counted as treated. In 2009, street sweeping totals decreased from previous years due to fuel conservation.

– School Yard Habitat

Frederick County Public Schools provided educational opportunities for students while improving stormwater management through various methods. Projects are constructed using a number of grant sources including CBT. Projects take place at school locations all over the county and the list continues to grow. The following projects have been completed through this program:

❖ Monocacy Elementary School (CCRP-62)

During 2006, second and third grade students constructed a wild meadow establishment using native plants. Though this project is a non-riparian buffer, it treats an estimated 0.25 acres of the Tuscarora Creek watershed.

❖ Thurmont Middle School (CCRP-64)

In 2004, 131 trees were planted on the campus to treat the Owens Creek watershed. Today, that count has decreased to only 15 or 20 surviving trees. In 2005, a Bayscape garden was created by over 200 community and school volunteers. Thorpewood, Maryland Equipment Incentive Fund (MEIF), and the PTA contributed to supplement

CBT grant funding. The school plans to incorporate some grassy areas next to the Bayscape garden into additional gardens.

- Governor Thomas Johnson High School (CCRP-137)

  Burning Bush was eradicated and about 400 native species were planted to control runoff. Over 95 students and members of the community participated during fall 2006. The school is adjacent to the Detrick Branch, which is a main tributary to Carroll Creek.

- Governor Thomas Johnson Middle School (CCRP-138)

  This school used bayscaping to address a bare spot on the campus where a downspout from the roof directly drains into the Carroll Creek. In 2005, 80 trees were also planted to create a buffer for the stream on the school grounds.

- West Frederick Middle School (CCRP-139)

  Over 1,100 live stakes were donated by the SCD in 2005 to complete the project. These stakes were installed into the stream bank to stabilize the area. A total of 3.6 acres of the Carroll Creek watershed is being treated.

- Thurmont Elementary School (CCRP-140)

  Through the Fountain Rock Nature Park, 100 square feet of native plants and trees are in the process of being planted on the school's property to treat a quarter acre in the Hunting Creek watershed. The school applied and received $194.15 from CBT for the planting.

- Tuscarora Elementary School (CCRP-148)

  During 2007, 200 volunteers participated in the planting of over 100 trees through a $2,091 CBT grant. These plantings will treat 0.407 acres of Ballenger Creek.

- Myersville Elementary School (CCRP-150)

  A tree and shrub planting treating approximately 0.01 acres was installed during 2006.

- Wolfsville Elementary School (CCRP-152)

  A tree and shrub planting treating approximately 0.18 acres was installed in 2007.

- Walkersville High and Elementary Schools (CCRP-153)

  A tree and shrub planting treating approximately 0.4 acres was installed in 2007.

❖ Valley Elementary School (CCRP-161)

Students, teachers, and parents installed a natural wetland area to treat approximately 0.5 acres. Additional tree plantings are scheduled for 2009.

❖ Oakdale Elementary School (CCRP-201)

A tree planting and native plant garden were installed in 2009, treating approximately 0.01 acres.

- Efforts in Other Watersheds

  – Brunswick Library (CIP-206)

  The Brunswick Library is undergoing renovation. Improvements to stormwater treatment include installation of a micro-bioretention and a surface sand filter. The total treated area is 1.67 acres. The micro-bioretention will treat runoff from the front parking lot. The parking lot is connected to the surface sand filter by an underdrain. Project installlation is scheduled for completion by 2011.

  – Citizens Care & Rehabilitation Center/Montevue Home (CIP-209)

  Two stormwater management facilities will be installed as a result of the redevelopment project. They will provide both water quality and quantity treatment. Water quality treatment will be provided by permanent wet pools with additional dry storage for channel protection. The total treated area is 25.16 acres.

  – Catoctin Mountain Park (MCWA-17)

  Catoctin Mountain Park increased the riparian buffer at the park headquarters parking area and has converted 0.5 acres of parking area from asphalt to turf block, an LID retrofit project that will reduce impacts on water quality in this brook trout stream. The park pulled the edge of the parking lot back from the stream by approximately 100 feet, restored the riparian corridor, and planted the area with native plants. If the project is successful, the park may remove more asphalt parking lots and replace them with LID. Currently they have planted perennial rye but may need to adjust the mix of grass types. The Park is an active member of the MCWA.

  – Fountain Rock Park (CCRP-57)

  Funded by the Chesapeake Bay Trust, the park used $3,100 to improve the habitat for the Checkerspot butterfly while not harming the existing habitat. Volunteers from the park and a local Boy Scout group created the site during fall 2006 and were able to treat an estimated one-acre area. In 2008, park staff began planning for the installation of a linear rain garden to treat additional stormwater runoff.

– Utica Park (CCRP-69)

  Approximately nine acres of treatment was produced by planting two screen areas with evergreens and a hardwood area in the middle of the park with native trees. Each County Commissioner planted a tree on opening day (April 26, 2007). Planting was done in accordance with a plan prepared by Mike Kay with Maryland DNR Forest Service. The edge of a wetland area was planted with 300 seedlings from the Growing Native project sponsored by Potomac Conservancy.

– Cooperative Extension (CCRP-131)

  This Master Gardeners project established the Nancy Adamson Native Hedgerow Garden on a strip of land between Montevue Lane and the parking lot of the Extension Office. Funding was provided by a Chesapeake Bay Trust grant. Trees from Tree-Mendous, DNR Forest Service were planted November 2005. Approximately at the same time, sedges were donated from North Creek Nurseries and perennials of native seed were donated from Nancy Adamson. Overall, an estimated half acre of impervious area reduction was achieved for Carroll Creek.

– Tom's Creek Stewardship Initiative

  Tom's Creek begins on the border of Pennsylvania and Frederick County near Emmitsburg. The projects below were supported with funding from the Chesapeake Bay Trust and Frederick County Division of Public Works. They were also supported by the Monocacy & Catoctin Watershed Alliance. The following projects have been installed under this initiative:

  ❖ New Forest Society Grow Out Nursery (MCWA-28)

    The organization supports landowners who use CREP by providing free replacement seedlings and technical assistance. NFS also has a grow-out nursery for native trees, assists young kindergarten students with planting trees, and encourages homeowners to create their own grow-out stations. An estimated 500 trees were distributed to elementary school students. For every fifty trees, 0.09 acres were treated.

  ❖ Mt. Saint Mary's Run (CCRP-145)

    During 2007, 164 native trees and shrubs were planted along a small tributary of St. Mary's Run, just east of Route 15 on the Mount's property. This will slow stormwater runoff and filter and absorb pollutants in a 0.54-acre area.

  ❖ Upland Tree Planting at Up County Family Support Center (CCRP-155)

    A riparian buffer planting was installed in April 2008. Over a hundred native plants provided 0.75 acres of treatment area. One 65-gallon rain barrel was also used at the center.

- ❖ Emmitsburg Elementary School on Willow Rill (CCRP-157)

  During 2008, the Potomac Conservancy assisted in planting a riparian buffer. The area planted treats approximately 0.93 acres..

– Waterford Park (MCWA-26)

  The first phase of this riparian buffer planting project was reported on in the 2005 Annual Report and is thus counted in the Table 7-5. However, no new phases were developed or completed during 2009, although future phases are anticipated. A total of 18 acres are treated in this project.

– Little Catoctin Creek (MCWA-41)

  The Town of Myersville restored one mile of Little Catoctin Creek in Myersville, Maryland. Working with U.S. Fish and Wildlife Service, the Town of Myersville conducted a comprehensive assessment of the Little Catoctin and applied this information to the stream restoration. The project included design and implementation of stream channel restoration, stream bank stabilization, and riparian plantings. Project partners include U.S. Fish and Wildlife Service and community organizations. Funding is provided by the U.S. Environmental Protection Agency.

– ThorpeWood (MCWA-43)

  The Thorpe Foundation installed a 1/4-acre model native plant demonstration garden in Frederick, MD. The site serves to educate landowners and contractors about the benefits of conservation landscaping through an awareness and education initiative. Project partners include Bechtel, BP Solar, and the Norcross Wildlife Foundation. Funding is provided by the U.S. Environmental Protection Agency.

– Brook Hill United Methodist Church (MCWA-48)

  The Brook Hill United Methodist Church built a rain garden next to their church and enlisted the help of ICPRB to obtain grant funding and help manage the project. The church agreed to help fund the project with $500 out of a total cost of approximately $5,500. The garden is about 1,000 square feet in size, and one side of the building drains directly to the area. Previously, runoff was routed to an underground drain, which drained to a ditch, and then to a tributary of Tuscarora Creek. ICPRB helped develop an educational sign explaining the benefits of rain gardens to fish and other organisms and was also on-site to assist during the installation process.

– Carroll Creek (MCWA-66)

  Frederick County WMS partnered with DNR to provide biologs for a stream restoration project behind the County's Cooperative Extension building along Carroll Creek.

– State Highway Administration - TEP (MCWA-77)

  The Maryland State Highway Administration (SHA) received funds from the Transportation Enhancement Program (TEP) to restore a small, unnamed tributary located between MD 180, the US 340/US 15 interchange, and Elmer Derr Road. The project involves stream stabilization along 1,300 linear feet of channel, treating 1.94 acres. Work included rock vanes, imbricated riprap walls, rock step-pools, and realignment of the stream channel. The project was completed in 2009.

– Cloverhill (MCWA-79)

  The first phase of this riparian buffer planting project was described in the 2005 Annual Report and is thus counted in Table 7-5. No new phases were developed or completed during 2009, although future phases are anticipated. The 2.1-acre planting treats 6.3 acres.

Evaluation: Based on BMP pollutant efficiency figures from the Bay Program and other sources, it is estimated that upon completion of NPDES-related projects, nitrogen will be reduced by 1,914.66 lbs/yr, phosphorus by 155.70 lbs/yr, sediment by 62,156.71 lbs/yr, and the total treated impervious area will equal 989.26 acres. The projects are all planned and funded at a minimum, with many completed. All meet the requirement to provide for the treatment of 672 untreated urban impervious acres. Frederick County continues to work towards restoration of its watersheds and BMP implementation and is proud to have excelled in this permit area.

In general, Frederick County has increased its commitment of staff time and resources to NPDES program activities over the permit term. In 2009, along with a full-time NPDES program manager, the program was supported by two other staff in its Watershed Management Section. The Community Restoration Coordinator (formerly the WRAS Program Coordinator, a position created in May 2003), has proved highly effective in the County's partnership restoration efforts. This position is funded jointly by DPW and grant funds. The County has secured grant funds to extend the support for this position through 2010. A full time Project Manager III staff person provides key support in wetland restoration, grant applications, GIS, Annual Report preparation, and other projects.